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THE STRIKE AT CREUSOT.

THE strike at Creusot has been brought to an end, but, in order to obtain such a happy denouement, it became necessary to have recourse to vigorous measures. The justice of the peace of Creusot, the sub-prefect of Autun, and the prefect of Saône-et-Loire were successively appealed to, but in vain. They were apparently persons of too light weight to pretend to quiet so great a conflict. Between the patronal and syndical power there was but a single mediation that could be admitted—that of the government.

In order to invoke the latter, the strikers intended to make a genuine pilgrimage to Paris by the caravan route. This design, looked upon as a mere fancy, appeared in reality to be serious enough to be alarming. The proof of this is that the government preferred to meet the strikers half way. In the wake of negotiations, the details and principals of which are of small moment, M. Waldeck-Rousseau, President of the Council of Ministers, assumed the responsibility of arbitration. How many steps had been climbed from the sub-prefect of Autun!

The exodus of several thousand workmen moving upon Paris by the great Bourgogne road was therefore reduced to the sending of a delegation by express train. During the entire day of October 7, proxies of the strikers and representatives of the management of Creusot pleaded their case pro and con before M. Waldeck-Rousseau.

It is unnecessary to say that the session was not public, and so we cannot tell our readers what took place therein; but we can, at least, make known to them those who took part in the debate. Of the representatives of labor, five were Creusot workmen—MM. Charleux, Renou, Lacour, Jussot, and Montel, president, secretary, and members of the committee on the strike. The others were what a dramatic author has called "bad shepherds," but let us style them "shepherds" solely, without qualifying them as either good or bad. Two of them, MM. Viviani and Gallot, were deputies. MM. Tourout and Maxence Roides are aspiring to



M. P. SCHNEIDER, MANAGER OF THE CREUSOT WORKS.

become such, and the latter is considered as having already captured the Creusot seat in the next elections, after a campaign of three weeks cessation of labor that has cost the workmen a million francs in wages. Finally, M. Quilès, municipal councilor at Marseilles, has traveled nearly half of France in order to allow M. Schneider's men to hear his good words, and nearly the other half in order to lend his valuable aid to the enterprise of pacification intrusted to M. Waldeck-Rousseau.

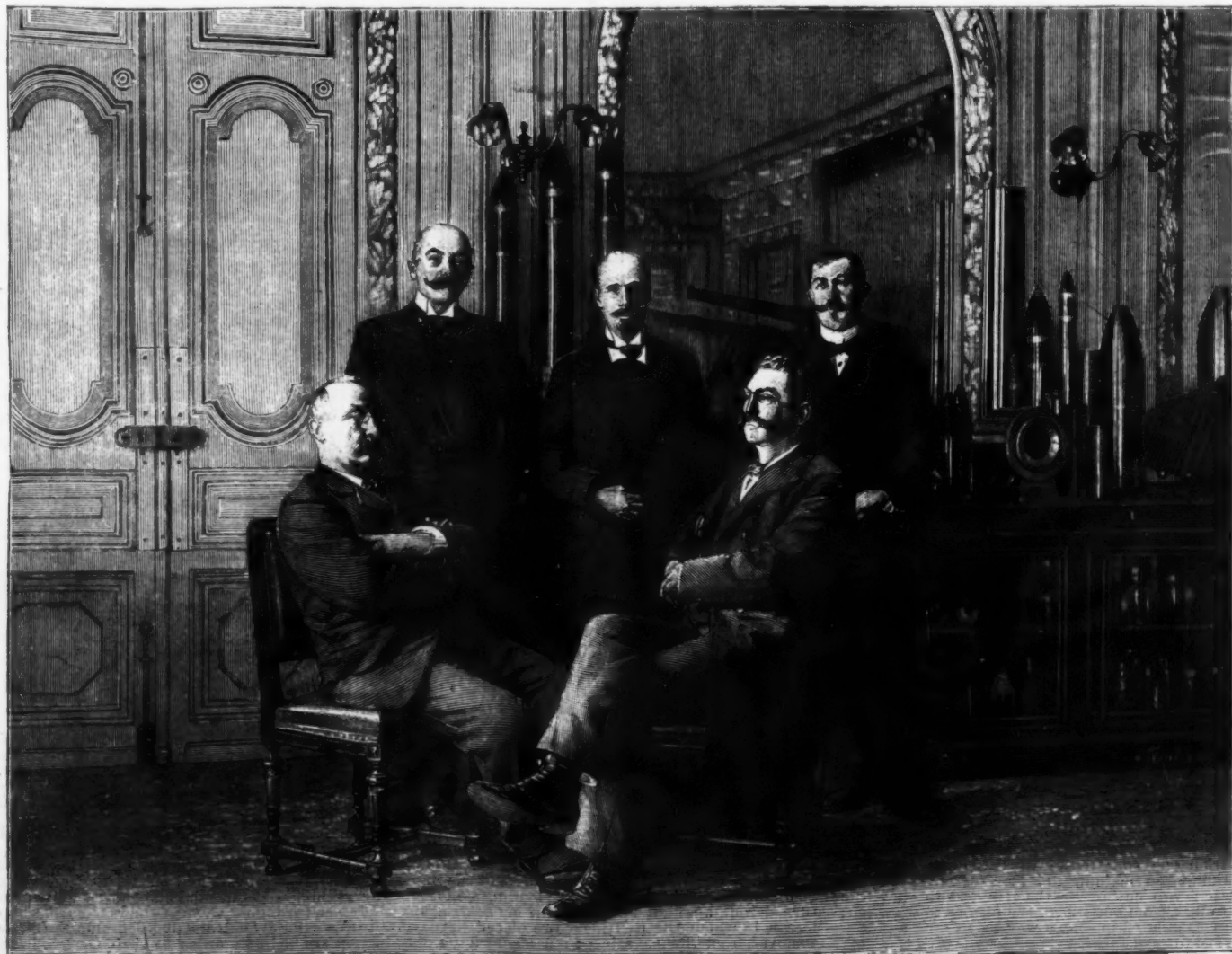
The representatives of the strikers have really gained a victory which they judge will be advantageous to all, and which will be, in fact, to some. They have made the manager of the greatest manufactory in France submit to the decision of a third; they have forced him to abdicate his absolute rights as "boss," and have created, complete in all its parts, a jurisdiction that has the power to decide for or against him, and before which there will be hereafter nothing for him to do but to bow.

It is at the seat of the Société du Creusot, Boulevard Malesherbes, at Paris, that we find ourselves in the presence of the adverse party depicted herewith.

MM. Lichtenberger, Saladin, Toussaint, Lapret, and Saint-Girons are engineers or head employés of the Schneider works. They are grouped in a curiously furnished room. Shells are placed along the walls and fill show-cases, and the mirrors reflect silhouettes of guns. These martial accessories have assuredly no role to play in the present conflict, and it is very certain that the mental dispositions of the distinguished engineers are infinitely more pacific than the murderous instruments amid which they allowed themselves to be photographed.

The representation of Creusot at the seat of arbitration was completed by M. Devin, advocate at the Court of Appeal. The following are the provisions of the decision rendered by the Minister of the Interior:

1. In fixing wages, either by the day or job, the company will take into account the increase promised in the month of June, 1899, without the



M. Toussaint. M. Lichtenberger. M. Saladin. M. Saint-Girons. M. Lapret.

DELEGATES OF THE CREUSOT WORKS AT THE SOCIETY'S HEADQUARTERS IN PARIS.

amount thus determined being modified by reason of contracts made by the company with its suppliers or customers.

2. It is well to state that the company does not claim to establish any difference between employees belonging or not belonging to labor unions. The management will recommend to its heads of departments and foremen to observe the strictest neutrality between the laborers.

3. The intermediary of the union to which one of the parties belongs may be profitably employed, if both consent to it, but it cannot be imposed.

4. The delegates of the workmen who every two months shall commend their claims to the management or one of its representatives, shall be appointed by the shops in the proportion of one delegate to the corporation.

5. No discharge shall be made on account of a strike or for anything done during the course of a strike.

6. In case a cessation of work should occur on account of the extinction of a blast furnace during a strike, a shift shall be established among workmen of the same category. The work shall be divided up between union and non-union men proportionally to their number in the force, as a whole, of works of the same nature.

As may be seen from the last paragraph, all the shops of Creusot could not be reopened immediately. The first important return of workmen to duty did not occur until Thursday.

Our article would not be complete without a portrait of Mr. Charles Prosper Eugene Schneider, the present manager of the great Saône-et-Loire works. Only thirty-one years of age, he comes fourth upon the list of superintendents of the powerful dynasty of the Schneiders, which has presided over the destinies of Creusot since 1836. Among the traditions that formed the retinue of such heredity, the first was the perfect unanimity between the management and the personnel of the works. This unanimity is now broken. M. Schneider nevertheless represents his workmen in the Chamber of Deputies, they having elected him in 1898 in place of his father.

For the above particulars and the engravings, we are indebted to L'illustration.

SCHNEIDER-CANET NAVAL TURRETS.

THIS is an important branch of the Schneider-Canet system of armament, both as regards the improvements carried out in successive turrets built, and the large number, for all calibers of guns, that have been supplied to the French and various foreign governments. The Schneider-Canet system was the first to embody balanced turrets with a central tube, and constructed to work either by electricity or by hand.

HYDRAULIC, NON-BALANCED TURRETS, FOR LOADING IN ALL POSITIONS.

As a type of this the Schneider-Canet turrets for 138.6-millimeter (5.456-inch) guns may be taken.

The turret consists of a platform with a conical wrought steel socket, the gun mounting, a hoist with loading platform, a means for the discharge of empty cartridge cases, and the mechanisms for lateral training and elevation of the gun. One side of the turret space is set aside for delivery of ammunition to the gun and the discharge of empty cartridge cases, the other side being reserved for operating the breech block, and the elevating and training mechanism. Ammunition from the magazines is placed in the hoist on the orlop deck.

The platform consists of two longitudinal and six transverse beams built up of plates and angles, and strongly fitted together with wrought steel flooring plates. It carries the gun and its mounting with the interposition of a cast steel bearing in the sides of which the trunnions are formed. Angles fitted to the ends of the beams round the flooring plates serve to fix the armor and backing to the platform. The turret is 1.8 meters (5 feet 10 3/4 inches) high to the springing of the top plates. The conical socket consists of two 13-millimeter (0.472-inch) steel plates lap-jointed together; the top enters a steel casting which connects the socket with the platform, and the lower part is closed by another steel casting which forms the pivot support. This pivot is of forged steel; it turns on a bush of hard gun metal placed inside a gun metal step bearing, which is bolted to a cast steel foundation plate. The rotation of the step bearing allows the height of the turret to vary by a few centimeters. The pivot, the step bearing, and the foundation plate are recessed in the center to receive the pipe that contains the water under pressure. The turret is guided in a cast steel ring fixed to a guide plate, the joint between the socket and the platform being lined with a gun metal friction ring which turns inside the cast steel ring.

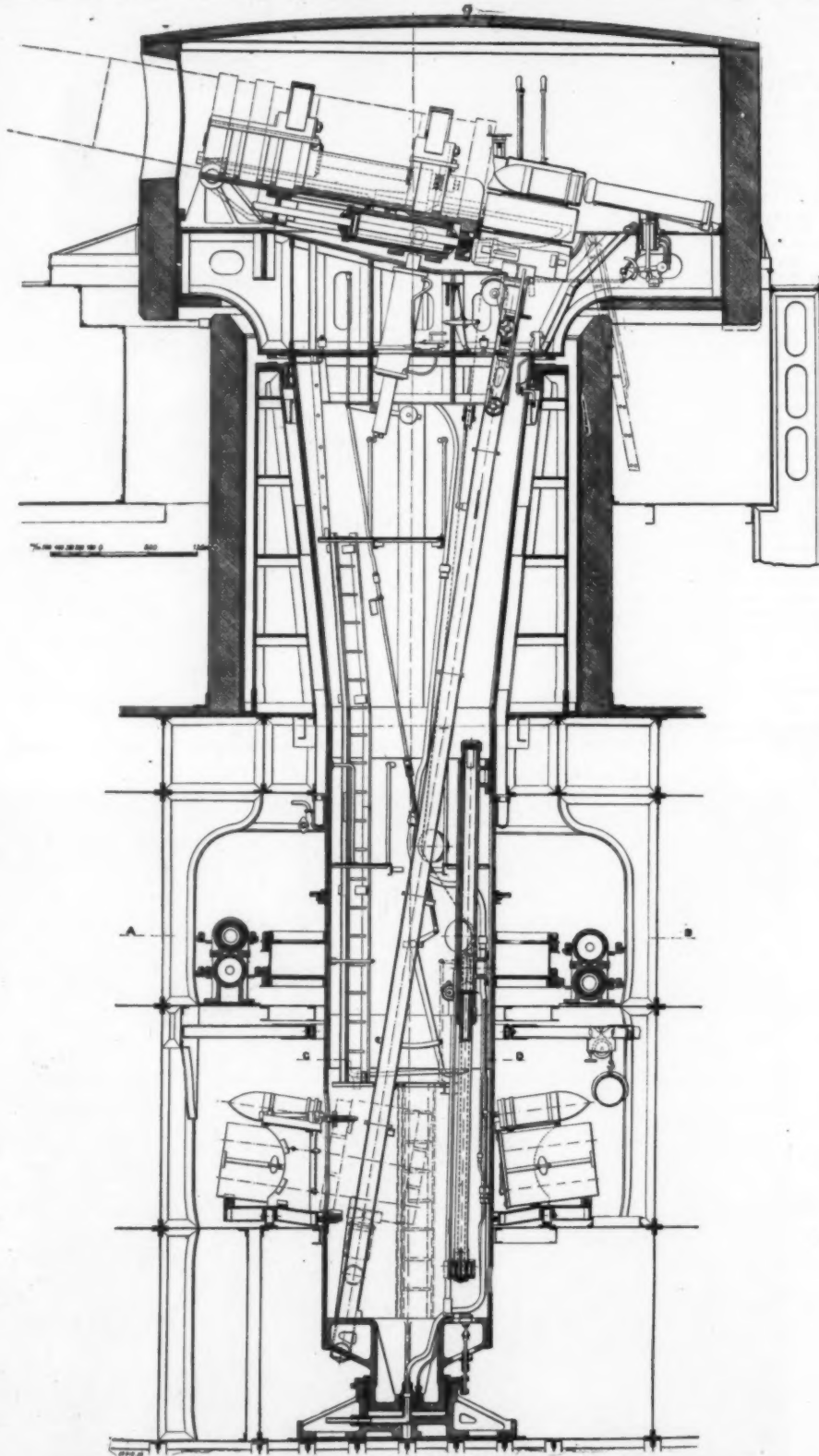
The gun mounting is arranged with limited recoil and automatic return; it consists of a trunnion carriage, two recoil slides, and a spring recuperator. The centers of the carriage trunnions and those of the recoil slides are in the same plane, the spring recuperator being placed underneath the carriage. The carriage is of cast steel, in two similar parts, connected vertically in front and at the rear. On the sides are the trunnions on which it is carried and the slides for the slide blocks. The jointed parts in front and in the rear form two jackets which serve as guides for the gun. These jackets are placed as far apart as possible and form very satisfactory guides. They are lined with gun metal, as also are the lateral slides, in order to reduce friction during recoil and return. The slide blocks are rectangular and are placed symmetrically; they contain the brake cylinders; two half rings welded to the blocks unite them together in a vertical plane. These half rings are made with projections which fit in grooves cut in the gun, thus causing the slide blocks to follow all the motions of the gun. Recoil is absorbed by the two recoil cylinders. The piston rods in front of the carriage pass through the cylinders from one end to the other, the volume in the brake therefore remaining constant. Grooves of varying sections are cut inside the cylinders to allow the liquid to flow from one side of the pistons to the other; they are calculated in such a way as to offer a practically constant resistance on the whole length of recoil, namely, 250 millimeters (9.843 inches). The recuperator consists of two sets of spiral springs symmetrical with

the gun. The springs bear on the rear end of two rods, the front ends being fixed to the front of the mounting. The springs are compressed during recoil through a forged steel crosspiece fixed to the half rings of the slide block. When the recoil is spent, the reaction of the springs runs out the slide blocks and the gun. The spring can be easily and quickly replaced. Return to firing position is controlled by the brake during the greater part of the travel and afterward by a hydraulic buffer.

The gun is supplied with ammunition by means of a hydraulic hoist and a loading platform. The hoist consists of a tube with a lateral opening, which serves as a guide for the ammunition, and of an endless chain, fitted at intervals with cleats or brackets that carry the cartridges. By working the chain, ammunition is delivered from the magazine on a lower deck to

opposite the hoist, and the gunner has only to slide the cartridge on its bottom to place it on the hoist. The automatic working of the loading platform is insured by gearing driven by the lower pulley of the endless chain, the various parts being so arranged that the hoisting of a charge corresponds with the shifting of the loading platform from one compartment to the next. On reaching the top, one end of the cartridge engages in a guide, and is prevented from falling when it leaves the hoist tube. The cartridges are placed by hand into the gun. The opening for discharging the empty cartridge-cases is cut in the rear of the turret in its vertical wall; it is closed by a cover and a double bolt.

The elevation of the gun, which ranges from -10° to $+15^{\circ}$, is obtained by causing the carriage to oscillate in the mounting by means of a double-acting hydraulic cylinder, the plunger rod of which is jointed to



TURRET GUN MOUNTING AND AMMUNITION HOIST ON THE FRENCH IRONCLAD "CHARLES MARTEL."

the gun, as it is required. The chain is operated by the plunger piston of a double-acting hydraulic cylinder. To this end the head of the plunger piston is provided with two jointed levers, bearing alternately on the spindles of the rising side and of the descending side of the chain, so that the chain always turns in the same direction round the pulleys whichever way the plunger piston acts. A spring cleat at the bottom of the hydraulic cylinder engages the chain automatically, and holds it fast when the motion of the plunger piston changes its direction. The loading table can be turned round, and it is fitted with concentric compartments, in which the cartridges are placed as they are removed from the magazines; it rests on a set of rollers that bear on a cast iron baseplate. Each compartment of the loading table is brought automatically

the underside of the carriage. This hydraulic cylinder is fitted to the mounting frame, its distribution valve being worked by the gunner from the turret. The gun is trained by means of two hydraulic cylinders placed under the armored deck, each working a plate chain, one end of which is fixed to the body of the hydraulic cylinder and the other end passing over a drum fixed to the turret socket. The lateral training mechanism is arranged so as to work the turret when the ship has a list of 5° , and to hold it fast under an angle of 15° . The delivery and exhaust of water under pressure take place through a valve at the bottom of the cylinders; this valve is loaded at 10 kilogrammes (142 pounds per square inch), in order to keep the chain taut and to fix the turret should the pipes leak or burst. The distribution gear of the lateral training cylinders is placed

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on the orlop deck in the cylinder space, but it is worked from the firing platform by means of a geared transmission placed in the turret, while in the pit, on a level with the distributor, are a wheel and an endless screw working a gun-metal disk to fix the system; this disk is made with two concentric grooves connected by an incline, and in which a roller travels fitted to the distribution valve rod. The difference between the radius of the concentric parts of the groove corresponds with the travel of the distribution valve. When the turret is not in service, the roller is in the middle of the incline, and by turning the disk one way or the other, the valve becomes displaced and causes one cylinder to be supplied with water under pressure and the other ready for exhaust. The turret is thus caused to turn, drawing the disk round with it; when the latter has resumed its former position, the valve closes and the turret stops. By this arrangement the turret is always under the gunner's control; the valve ports are calculated so as to insure the required precision in the training of the gun. Six men are required for operating the turret and serving the gun.

Schneider-Canet Turrets for 305-millimeter (12-inch) Guns.—The principal parts of these turrets are the mounting, training, and elevation mechanisms, loading apparatus, distributors, and safety devices, provided for the various operations. The gun is held on the carriage by means of cramps, rings, and pins. The center of gravity of the gun being in front of the bearing base, the carriage rests in front on a trunnion block, while in the rear it throws a vertical strain on the clamps. The sides of the mounting serve as slides for the carriage; they are joined in front by a stay, and in the rear by the cylinder for working the gun. This is in one piece with the mounting, the double-acting piston rod being fixed to the lower rear end of the carriage. During recoil, the liquid driven from the rear passes to the front through loaded valves and pipes. In order to cause the recoil cylinders to take up the largest possible portion of the recoil, the valves are only loaded to about 32 kilogrammes (455 pounds per square inch), a sufficient pressure to keep the gun run out at all angles. When water under a pressure of 80 kilogrammes (1,138 pounds per square inch) is introduced in the rear of the cylinder for running out the gun, the valves are exposed to an extra hydraulic pressure which keeps them closed until the instant that firing takes place. As soon as recoil commences, this surcharge is removed. The recoil cylinders are cast on the sides of the carriage; during recoil the liquid passes from the rear to the front through vents in the pistons. The pistons are provided with counter-weights in front.

The revolving platform, built of steel plates, carries the mounting and the gun, as well as the protective armor; it is bolted to the top part of the socket. The latter transmits the whole weight of the movable turret to the ship's framings; on the top is a gun metal ring which slides inside the circular guide, and ends at its lower part with the hydraulic pivot. This can travel vertically over 40 millimeters (1.575 inch) in a step bearing, the travel being regulated by an automatic valve mounted on the pivot, the rod of which is joined to the step bearing in such a way that the admission of water under pressure underneath the pivot is closed by the turret itself when it reaches the firing position, and opened if the turret has a tendency to get lowered. Special latch-bolts on the platform lock the turret when it is not in service; these bolts are set under the action of springs, and are pushed back when the water under pressure acts underneath the plunger pistons. A safety device prevents setting the bolt-valve for water admission, and the turret cannot be freed for lateral training if the pivot valve has not been adjusted previously for admission. A finger joined to the pivot valve prevents its being set for exhaust if the latch bolts are not home in their catches. The hydraulic cylinders for elevation are placed on the lower part of the platform; they each contain a double acting piston, the top part of the rod forming a sheath in which is a connecting-rod jointed at one end to the mounting frame, and to the piston at the other end. The connecting-rod heads are provided with spherical bushes which allow a certain lateral motion of the mounting frame. Single acting horizontal hydraulic cylinders, placed transversely on the orlop deck, two in front and two in the rear, regulate the lateral training by means of plate chains and pulleys. The plungers are guided by slides fixed at one end to the cylinders and at the other end to the sides of the ship. Handwheels for lateral training are placed in the turret; they are turned in the same direction as the turret. Ammunition is supplied to the gun by a special hoist, suitably arranged and provided with devices for insuring safe working. This type of turret, as fitted on the French ironclad "Charles Martel," is shown in our illustrations.

AMERICAN RAILROADS.

THEIR RELATION TO COMMERCIAL, INDUSTRIAL AND AGRICULTURAL INTERESTS.*

Mr. Chairman and Gentlemen of the International Commercial Congress:

I congratulate the United States, and every commercial country on the globe, upon the interest which this congress has inspired, and which has secured the attendance of the representatives of commercial bodies from practically every country of the world.

I also congratulate the city of Philadelphia, the greatest manufacturing city in the United States, upon the public-spirited character of its citizens, who have organized and carried to a successful issue the National Export Exposition.

The holding of such expositions as this, and the Pan-American Exposition to be held in Buffalo in 1901, cannot but be of great value in aiding the extension of international commerce, and the whole world is interested in its extension.

AN AGE OF TRANSPORTATION.

One of our great writers has said of this closing period of the nineteenth century, that it is an age of transportation.

Transportation underlies material prosperity in every

*An address by George H. Daniels, General Passenger Agent, New York Central & Hudson River Railroad, and President of the American Association of General Passenger Agents, before the International Commercial Congress, at Philadelphia, October 25, 1899.

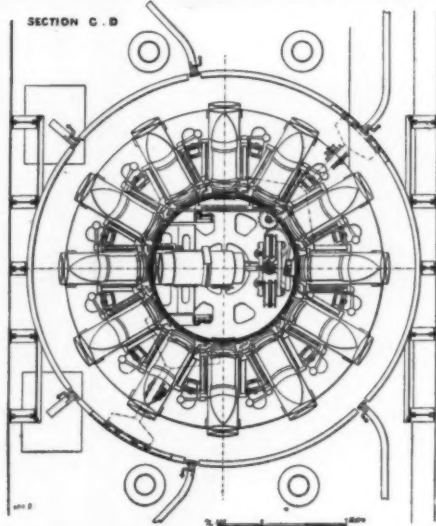
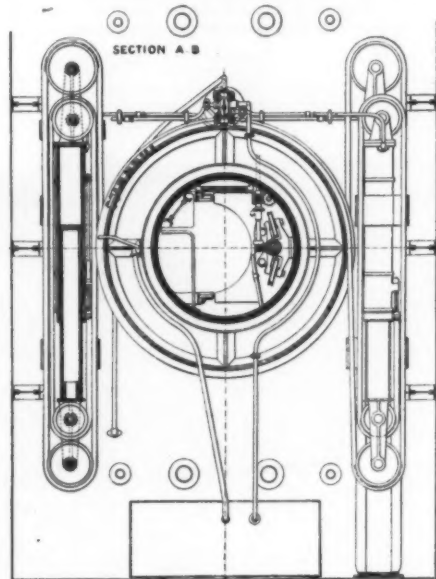
department of commerce. Without transportation commerce would be impossible.

Those states and nations are rich, powerful and enlightened whose transportation facilities are best and most extended. The dying nations are those with little or no transportation facilities.

Mr. Mulhall, the British statistician, in his work on "The Wealth of Nations," said of the United States in 1895: "If we take a survey of mankind, in ancient or modern times, as regards the physical, mechanical and intellectual force of nations, we find nothing to compare with the United States."

Mr. Mulhall proved by his statistics that the working power of a single person in the United States was twice that of a German or Frenchman, more than three times that of an Austrian and five times that of an Italian. He said the United States was then the richest country in the world, its wealth exceeding that of Great Britain by 35 per cent., and added that in the history of the human race no nation ever before possessed forty-one millions of instructed citizens.

Should Mr. Mulhall revise his figures to-day, the differences would all be in favor of the United States, for in the past eighteen months we have demonstrated the superiority of our manufactures in every direction, and our ability to cope successfully with questions



SECTIONS OF GUN TURRETS.

which have heretofore been handled exclusively by the older nations is now recognized by all the world.

RESULTS OF WAR BETWEEN JAPAN AND CHINA.

In an address before the New York Press Association, four years ago, I referred to the future of our export trade, as follows: "One of the inevitable results of the war between Japan and China will be the opening to the commerce of the world of fields heretofore unknown, perhaps the richest on the globe;" and in urging the members of the New York Press Association to do everything in their power to assist in securing to the United States a portion of the great commerce to be developed between the western nations and these two old countries of the world, I asked these questions:

"Shall the grain in China and Japan be harvested by machines manufactured in the United States, or will the manufacturers of England and Germany supply them?"

"Shall the fires in Yokohama and Tientsin be extinguished with engines built at Seneca Falls, or will France or England send their fire engines to Japan and China?"

"Will the locomotives to haul the fast mail trains between Yokohama and the interior of Japan and through the rich valleys of China be built at Schenectady, Philadelphia or Dunkirk, or will our Oriental friends and neighbors in the Pacific buy them of our English cousins?"

I predicted that active efforts toward the extension of American commerce by commercial bodies, supported by a liberal and broad-minded policy on the part of our government in connection with the aggres-

sive action of the transportation companies, would undoubtedly secure to the United States the blessings that come from a great and varied commerce, and I said that the New York Press Association, and similar associations all over the country, could stimulate a public spirit that would insure the important results outlined.

At that time we had no idea that a war between one of the old nations of the earth and our young republic would be fought; at that time we had no idea that American manufacturers would be furnishing locomotives to the English railroads as well as to those of nearly every other country on the globe. No one thought four years ago that American bridge builders would go into the open market and successfully compete for the building of a great steel bridge in Egypt; nor that in so brief a time American engineers would be building railroads into the interior of China from her most important sea-ports.

At that time no one supposed that the Trans-Siberian Railway would be laid with steel rails made in Pennsylvania, upon cross-ties from the forests of Oregon, and that its trains would be hauled by American locomotives; nor that this great railway, which is to stretch from St. Petersburg to Vladivostok and Port Arthur, a distance of more than 6,000 miles, would be completed two years in advance of the original expectation, as a result of the use of American construction tools and machinery.

But this is all true, and it is further true that the tools and machinery for the construction of the western portion of the Trans-Siberian Railway were supplied by American manufacturers, at about one-half the price that Russia had been paying previously, and with this American machinery the Russians are able to do nearly double the work that they could perform with the machinery manufactured in other countries.

AN EMPIRE EXPRESS IN THE ORIENT.

In a letter from a friend in Tokio, Japan, written only a short time ago, there was this significant sentence: "You will be interested in knowing that I have hanging on the wall of my office a framed picture of your 'Empire State Express,' and we expect in the near future to be hauling a Japanese 'Empire Express' with an American locomotive." They have now in Japan more than one hundred locomotives that were built in the United States. In Russia they have nearly one thousand American locomotives, and practically every railway in Great Britain has ordered locomotives from this country since the beginning of the war with Spain.

In this connection it will be interesting to note in passing that the second American locomotive was built at the West Point foundry, near Cold Spring, on the Hudson River, and was called the "Best Friend," and from that day to this the locomotive has been one of the best friends of this republic.

OUR SUPERIOR RAILWAY EQUIPMENT.

But it is not alone our locomotives that have attracted the attention of foreigners who have visited our shores; our railway equipment generally has commanded admiration and is now receiving the highest compliment, namely, imitation by many of our sister nations.

Prince Michel Hilko, imperial minister of railways of Russia, has, since his visit to the United States a few years ago, constructed a train on much the same lines as the "Limited Trains" of the New York Central and the Pennsylvania.

Only a short time ago, at the request of one of the imperial commissions of Germany, I sent to Berlin photographs of the interior and exterior of our finest cars and other data in relation to the operation of American railways. Several other countries have asked for similar information, and there is a general waking up of foreign nations on the subject of transportation, brought about mainly by the wonderful achievements of American railways.

The demand for American locomotives from all parts of the world is attributable, in the first place, to the superior quality of our machinery, and in the second place, to the fact that the general passenger agents of the American railways have, through their advertising, made the marvelous results accomplished by our locomotives household words in every country on the globe.

A NAVAL OBJECT LESSON.

The admiration of foreign nations for us is not by any means confined to railways. One incident that startled the entire world and directed the attention of thinking people everywhere to American achievements in machinery was that of the United States battleship "Oregon," built at the Union Iron Works in San Francisco, and which steamed a distance of more than half round the globe without loosening a bolt or starting a rivet, and arrived at her post off the island of Cuba prepared to perform any service required of her; and then, having given a most satisfactory account of herself on that memorable third of July, 1898, off Santiago, she steamed back to the Pacific, and without unnecessary delay crossed that great ocean to join Admiral Dewey's fleet at Manila. On her arrival there the Secretary of the Navy received one of those condensed messages for which the Admiral—who has shed undying luster upon the name of the American navy—is so noted, which read as follows:

"MANILA, March 18, 1899.

"The 'Oregon' and 'Iris' arrived to-day. The 'Oregon' is in fit condition for any duty. DEWEY."

These demonstrations of what American shipbuilders can accomplish created a desire on the part of every naval power in the world for ships of the character of the "Oregon," and the logical conclusion of thinking people was that if we could build ships like the "Oregon," anything else that we built must be of a superior quality, and the demand for American manufactures began to increase and is increasing with each day, until thousands of our factories are now running night and day, and business in the United States was never in a more prosperous condition than it is in these October days of 1899.

TRADE AND THE FLAG.

It has been said by a great American writer that "Trade follows the flag." Recent events have placed

our flag upon the islands of the Pacific, directly in the natural track between the Pacific coast of the United States and Japan and China, and as we contemplate our growing commerce with these old nations, we are reminded of the prophetic statement made at the completion of the first continuous line of railroad between the Atlantic and Pacific Oceans by the joining of the Union and Central Pacific Railroads more than thirty years ago by that prophet of his time, Thomas H. Benton, who, standing on the summit of the Rocky Mountains and pointing toward the Pacific Ocean, said: "There is the East; there is India."

Previous to the construction of this artery of commerce, the route to India had been by the way of our Atlantic sea ports and Europe, but with the completion of our transcontinental system of railways, the route was changed, and a better way was found by way of the Pacific sea ports and the Pacific Ocean.

OUR COMMERCE IN THE ORIENT.

There are some who seem to think that we might get along without trade with China, and that it is a new fangled idea that Chinese trade can especially benefit the United States.

Commerce with China began one hundred and fifteen years ago, the first vessel sailing from New York on Washington's birthday in the year 1774. This vessel returned to New York May 11, 1775. The success of the venture was such as to warrant its repetition, and from that day to this trade between the United States and China has continued without material interruption until it is now greater in importance and value than that of any other nation trading with China with the single exception of Great Britain. If we are to continue as one of the great nations of the world, we can hardly afford to ignore a country that comprises one-twelfth of the land area and nearly one-fourth of the population of the globe.

CHANGE IN SENTIMENT.

At times there have been periods of legislation in the United States adverse to the great transportation interests of the country, almost invariably the result of a misunderstanding of the real situation, and the hasty legislation of such times has usually been repealed upon the sober second thought of the people, for in the language of our great Lincoln, "You can fool all the people some of the time, some of the people all the time, but you can't fool all the people all the time."

A striking illustration of the change in sentiment which has taken place in the public mind in regard to railroads is the recent election by the Legislature of New York to the United States Senate of the Hon. Chauncey M. Depew, of New York, a man whose whole life has been spent in the closest association with the transportation interests of the country. This event is especially significant, and marks a new era in the history of our country—an era of better understanding and closer and more amicable relations between the commercial, agricultural, and industrial interests and the transportation interests of the United States.

ITS PECULIAR SIGNIFICANCE.

The election of so prominent a representative of the transportation interests of America to one of the highest political positions in the gift of the people, came with peculiar significance in the same week and almost on the same day that two of the imperial governments of Europe gave to the world their indorsement of the idea that modern transportation facilities form the surest foundation upon which to build and sustain a nation.

GERMANY EXTENDS ITS RAILROADS AND PRAISES OURS.

The Emperor of Germany in his speech to the Prussian Diet, in January last, did not lay the greatest stress upon the necessity for increasing the army, or for the construction of additional ships for the navy, but he did impress upon his hearers the great importance of extending the railroads and the navigable canals.

In order that the German nation might have knowledge of the most advanced theories and practice in the construction and operation of railways, an Imperial German Commission was sent to the United States a short time ago for the purpose of examining American railways and making such recommendations as their investigation should suggest.

In the report of this commission, which was recently published, one of the first sentences is as follows: "Lack of speed, lack of comfort, lack of cheap rates, are the charges brought against the German Empire's railways, as compared with those of the United States." They recommended the adoption of many of our methods, explaining in their report that they were far superior, not only to those in vogue in Germany, but also superior to those of any other country.

INFLUENCE OF RAILROADS IN RUSSIA.

The Budget of the Russian Empire for 1899 discloses the almost incredible efforts in railway extension that the imperial government of the Czar is putting forth; in this year alone, one hundred and nine million rubles will be devoted entirely to the railways, and during the past twelve years four hundred and twenty-five million rubles have been thus expended.

The immense sums which the Russians are devoting to the extension of their railways entirely overshadow the demands of both the army and navy.

RAILROAD MEN IN THE CABINET OF THE CZAR.

It is a fact not generally known that the two men who are nearest to the Czar of Russia, and who, perhaps, have a greater influence than any others in shaping the commercial policy of the present government of that great empire, are M. de Witte, the Imperial Minister of Finance, who sixteen years ago was a station agent at a small town on one of the railways of Russian Poland; the other is Prince Michel Hilkoff, who when little more than a boy left St. Petersburg to seek his fortune, learned mechanical engineering in the city of Philadelphia, and who is to day the Imperial Minister of Railways of the Russian Empire, and a member of the Cabinet of the Czar.

CHINA JOINS THE ARMY OF PROGRESS.

More than twenty years ago one of the Imperial Ministers of China, in a report to the Emperor and

Empress, urged upon them the construction of a system of railways from their principal ports to the interior of the empire. In his report he used this significant sentence:

"Japan, which is a mere speck upon the map, is building railways, and her people are being benefited thereby. Should not your Celestial Empire, which comprises one-twelfth of the land area and one-quarter of the population of the globe, do as well as this handful of people among the islands of the sea?"

To-day this suggestion is being carried out, and railroads are being constructed in a dozen different directions in China.

RAILROADS SUPERSEDE CANALS.

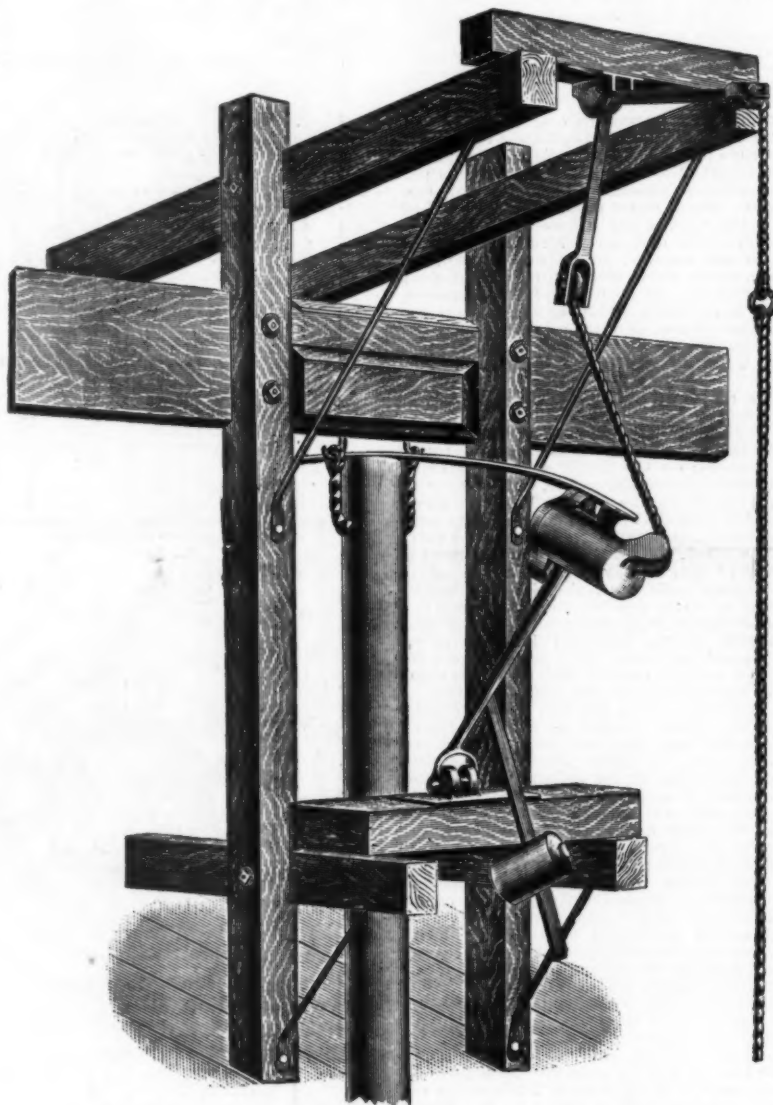
One hundred years ago the Governor of the great State of New York advised his friends not to invest their money or waste their time in aiding the building of railroads, expressing the opinion that while it was possible that improved methods of construction and perfected machinery might, in the remote future, enable the people to move a car upon a railroad at the rate of five or six miles per hour, he did not believe that they could ever be made of material advantage, and that any attempt to transport passengers and freight by railroad, from one part of the country to another, must result in endless confusion and loss. The Governor died in the belief that the canal was the only means of conveyance for a great commerce.

TUBULAR BELLS.

It is unfortunately one of the characteristics of an ordinary belfry bell that its bronze voice, in order that its full power may be shown and the resistance of the air be overcome, requires to be served by an imposing mass of metal; while the singularity of the form of the bell renders its accord difficult. The normal *la* of 870 simple vibrations which is found in the center of the keyboard of the piano and is furnished by the human voice, and which in acoustics carries the qualitative of *la* (3), can be given only by a bell of 36 inches diameter weighing at least 990 pounds. The *do* (3) which opens the octave to which the normal *la* belongs is a bell 5 feet in diameter and of 4,400 pounds weight, at a minimum. The *do* (2), that of the Savoyarde, a bell of 9'8 feet opening, and the weight of which varies between 35,000 and 40,000 pounds, may be obtained with less complicated instruments and may be almost reached by the vocal cords.

As for the gravest *do* that the ear can scarcely differentiate, and the *do* (-3) of the 33 vibrations that the organ can give forth from a 32 foot pipe, these would require, for obtaining them, a bell 105 feet in diameter, representing the respectable weight of seventeen and a half million pounds.

At the present price of copper, great bells are almost too costly to purchase. The use of them, moreover, would be very difficult, and the Savoyarde may be con-



ARRANGEMENT OF A TUBULAR BELL AND ITS HAMMER.

Notwithstanding his prediction, the railroads have grown to such vast proportions that to-day the world's entire stock of money, gold, silver, and paper, would not purchase one third of its railroads.

The building of the Erie Canal, extending from Buffalo to Albany, a distance of 363 miles, was commenced July 4, 1817. It was completed in 1825 at a cost of \$7,602,000. In 1896 the State of New York appropriated \$9,000,000 for enlarging and improving this canal, and a few figures from the State report on canals may be of interest in this connection.

Reliable statistics of its traffic are not obtainable for the earlier years of its operation, but in accordance with the last annual report of the Superintendent of Public Works of the State of New York we find that the tonnage of all the property carried on all the canals in both directions in 1837 was 1,171,296 tons, valued at \$55,809,288.

The tonnage and the value increased until 1872, when it amounted to 6,673,370 tons, valued at \$220,913,321.

From 1872, the tonnage and the value of the property carried decreased, until in 1897 there was only 3,617,804 tons carried, with a value of \$96,063,338.

This, in face of the fact that the receipts of grain and flour at Buffalo had increased from 1,184,685 bushels in 1837 to 242,140,306 bushels in 1897.

(To be continued.)

The Jewish year book estimates that there are in the world about 11,000,000 of that race, more than half being under Russian jurisdiction.

sidered as the largest that it is practicable to manufacture.

It is especially when we desire to obtain accords and form chimes capable of playing certain airs that the rapidly increasing weight of the bells (and especially their cost) becomes an obstacle. Such increase is, in fact, proportional to the cube of the diameter: as from one note to its octave, the diameter doubles; it results from this that, as soon as we have united an octave of bells, some of them are heard to a much greater distance than others. It might be said that it is the smallest bell that is the dominant one. The excess of the weight of the others over the weight of this is absolutely lost from the viewpoint of the general range of sound.

Mr. Harrington, an Englishman, struck by this inconvenience, succeeded some years ago in producing bells that were absolutely cylindrical and that completely did away with the difficulty. Whatever be the note that is to be furnished, the tube that gives it is of constant diameter and thickness. The various tones and semi-tones differ only in length. The result is a great saving in metal and the possibility of obtaining notes with mathematical precision.

Such an advantage is not a slight one, since the harmonizing of the ordinary bells necessitates an installation on a large scale, extraordinary care, and an extremely musical ear.

The Harrington tubular bells, by virtue of the very principle of their construction, all have the same range which is naturally less than that of ordinary bells; but as an offset, they can be established in five different

diameters corresponding to respective ranges of from $\frac{1}{4}$ mile to 3 miles.

There is of course no reason why tubes of greater diameter may not be established so as to be heard at still greater distances.

To show the difference in weight between a tubular bell and an ordinary one having the same range, it may be stated that one of the former of $2\frac{3}{4}$ inches diameter and a range of half a mile weighs but 1,540 pounds, while one of the latter with the same range weighs 66,000. In the first case, it is a question of an expense of \$1,200, and, in the latter, of \$20,000. If we take tubes of a range of 3 miles, we shall obtain an accord in all respects comparable to that of ordinary bells, for \$4,600. Even in this case there will be a saving of \$15,000 in metal, and almost a complete absence of costs of installation. It suffices, in fact, to suspend the tubes from a large beam; and as their maximum length is but 10 feet, it will be seen that they occupy but little space. Our engraving, borrowed from *La Science en Famille*, shows the arrangement of one of these tubular bells and its hammer.

GASTON TISSANDIER.

APPLIED science, in all its branches, has recently met with a severe loss in the person of Gaston Tissandier, who died August 30, after a long sickness.

M. Tissandier, who was born at Paris March 21, 1843, was the great-grandson of Lheritier de Brutelles, a member of the Académie des Sciences. After graduation at the Lycée Bonaparte, his tastes led him to the study of chemistry, for which purpose he entered the laboratory of P. P. Deherain at the Conservatoire des Arts et Métiers, and, at the same time, attended lec-

some expeditions of this kind after such an experience; but Gaston Tissandier was not that kind of a person. Between 1881 and 1884, in conjunction with his brother Albert, he devised, experimented with and improved an electric dirigible balloon propelled by a screw. This balloon, which was operated during the entire period of the Exposition of Electricity in 1881, was a model of one that was subsequently constructed on a larger scale and that became the starting point of the Chalais-Meudon military balloon.

Gaston Tissandier held an important place in all learned societies. He was president of the Société Française de Navigation Aérienne, which, in 1876, gave him a gold medal; president of the Conférence Scientia; and member of the Commission on Aeronautics at the War Office.

He published numerous works upon chemistry, geology, photography and hygiene, and, with his brother Albert, was the founder of *La Nature*.

He was made Chevalier of the Legion of Honor in 1872; and in 1893, upon the report of Colonel Laussedat, received the grand gold medal of the Société d'Encouragement pour l'Industrie Nationale.

He was an indefatigable worker, and death alone could impose upon him a well earned rest.

For the accompanying engraving, representing M. Tissandier in his study, we are indebted to *La Nature*, to the interests of which he devoted a great part of his life.

PROGRESS IN CHEMICAL ARTS.

At a meeting of the American Chemical Society, Oct. 10, Dr. Wm. McMurtrie of this city read a paper upon "Progress in Applied Chemistry," treating particularly

way, to vitriol, yielding daily ten tons of finished acid of very high purity.

"The electrolytic production of chlorine and its compounds," said Dr. McMurtrie, "has undergone considerable increase in the last year. Hancelever says the extension of electrolytic chlorate manufacture, both in Sweden and French Switzerland, has been so active that the price has fallen in Germany from 100 to 120 marks per 100 kilogrammes to about 55 marks, and that many factories have resorted to the manufacture of other products. Particularly, carbide production of chloride of lime has so increased that increasing quantities are available for export. The president of the United Alkali Company stated to the stockholders that while in 1895 the export of soda from England to America was 125,698 tons, it had fallen to 29,393 tons in 1898. During the same period caustic fell from 33,625 to 11,171 tons, and chloride of lime suffered in the same way. The company had established works at Bay City, Michigan, to supply the American market. The National Electrolytic Company at Niagara Falls now use 1,100 horse power, supplied by the Niagara Falls Hydraulic Power Company, in the production of potassium chlorate, using the process of W. T. Gibbs. They are now doubling the works.

"The commercial production and utilization of ozone is extending. Kershaw discusses the more recently improved forms of apparatus for the purpose, and particularly those of Andreoli, Otto, and Yarnold. According to Kershaw, ozone produced by the apparatus of Yarnold, Otto, and Andreoli is three to four times as expensive as bleaching powder and about fifty per cent. more expensive than sodium bichromate as a source of active oxygen. . . . Andreoli recommends purification of water with ozone, and states that after



GASTON TISSANDIER IN HIS STUDY.

tures at the Sorbonne and the College of France. The position of preparator at the laboratory of experiments and analyses of the Union National having become vacant, he accepted it. A year later, at the age of twenty-one, he was made superintendent of this important establishment, and not long afterward was placed in charge of the Chambre Syndicale de Produits Chimiques at Paris. Notwithstanding his manifold duties, he found time to pursue personal researches, and discovered, among other things, a new yellow coloring matter in coal tar.

His peculiar talents for physics and meteorology soon led him to take an interest in aeronautics and the attractive problems that it offers to its adepts. In this study, he found a fellow laborer in his brother Albert, the distinguished artist and explorer. His first balloon ascension was made August 16, 1868, in company with the intrepid aeronaut, Durnof. After this, in company with his brother, he made no less than forty-four ascensions, four of which took place during the siege of Paris. At this period the two brothers were incorporated in the Army of the Loire as military aeronauts.

Then followed the great scientific ascensions. On March 23, 1875, Tissandier, in company with Crocé-Spinelli, Sirel, Jobert, and his brother Albert, made an uninterrupted aerial voyage of twenty-three hours between Paris and Arechon. This aeronautic record was made upon the balloon called the "Zenith."

Three weeks afterward, on April 15, Tissandier, Crocé-Spinelli, and Sirel started in the same balloon to make an ascension to a great height. When the balloon touched earth again after having attained a height of 28,200 feet, two of the occupants of the car were found to be dead, while the third was unconscious. The survivor was Tissandier.

Almost anyone else would have given up adventure-

of the progress made in the last year, and dealing exclusively with those new discoveries which have been immediately availed of for practical purposes. Dr. McMurtrie prefaced his paper with a large number of statistics of American imports and exports, showing that the demand for raw materials used in the chemical arts is on the increase in this country. The United States have exported in greatly increased quantities the products of this country, while those incapable of production here have been imported upon a scale hitherto unknown.

The growing interest in the chemical industries, said Dr. McMurtrie, has been shown in the number of expositions held in the last year, the work of which he reviewed. He then gave specific instances of progress. The cyanide process for extracting gold has been widely applied, and it is said that forty works are being operated with it in the United States. The Hoespfer process for extracting copper also seems to be extending, and the Mond process for extracting nickel has been further developed, as has the Goldschmidt process for obtaining high temperatures and reducing refractory metallic oxides by combustion of aluminium.

Silicon, said the speaker, has been produced in the electric furnace. In Frankfort rods of silicon have been brought into the market, especially recommended for use in the manufacture of iron and steel. The production of phosphorus in the electric furnace has been further developed in the last year, and several forms of furnace have been devised for heating materials with exclusion of air and with reducing media, together with the condensation and collection of the volatilized products. Hydrogen sulphide, continued Dr. McMurtrie, is found in considerable quantity as a by-product in asphalt refining in the California Asphaltum Works at Ventura. It is burned into sulphur dioxide, and this, in turn, is converted in chambers, in the usual

treatment of water containing from 6,000 to as high as 110,000 micro-organisms per cubic centimeter, the results in eleven trials showed that no active organisms remained; in ten other trials ten organizations per cubic centimeter were found, and the largest number found, after four other trials, was forty.

"The production of liquid air is progressing and it is fair to believe that it will find practical application. A company has been established in New York city for the manufacture of liquid air, and claims a daily capacity of 1,500 gallons. Facts regarding cost of the product are not easily obtainable, but there is reason to believe that it can be produced at low expense. Hempel states that the Linde machine yields per horse power hour one cubic meter of air, containing fifty pounds of oxygen. He states that though its chemical uses thus far have been limited to making an explosive, in the Deacon process it should also serve a useful purpose in making producer gas, whereby, in the product, the carbon monoxide and hydrogen would be increased about 100 per cent, and the nitrogen reduced to a corresponding extent."

Those who find a use for cryptic methods will be interested in the "Padlock cipher." Twenty-six card slips are employed, each having a capital letter in black on the left-hand side, as well as two alphabets in horizontal lines, the upper row in black and consecutive from a to z; the lower row in red, but with a broken alphabet, so that no letter is similar to the letter above in the top row. The back of each slip has the same capital letter on the left hand side, but printed in red, and it also has two alphabets, the upper row consecutive in red, the lower being also a broken alphabet as on the other side of the slip, but printed in black. A keyword is agreed upon between

the sender and receiver; the former arranges the slips so that the black capitals spell the keyword, picks out his message letter by letter from the black alphabet, and writes down the corresponding red letters in the lower alphabet. The receiver arranging his slips so that the red capitals spell the keyword, reverses the process, and so solves the cryptogram. It is claimed that solution is impossible without a knowledge of the keyword, recurrence of letters affording no clue, as the same letter may, in rotation, represent all the letters of the alphabet.—The Engineer.

(Continued from SUPPLEMENT, No. 1245, page 19954.)

MECHANICAL SCIENCE.

OPENING ADDRESS BY SIR WILLIAM WHITE, K.C.B., LL.D., F.R.S., PRESIDENT OF THE MECHANICAL SCIENCE SECTION, BRITISH ASSOCIATION.

INCREASE IN SIZE AND SPEED OF WARSHIPS.

TURNING from sea-going ships of the mercantile marine to warships, one finds equally notable facts in regard to increase in speed, associated with enlargement in dimensions and advance in propelling apparatus, materials of construction, structural arrangements and form.

Up to 1860 a measured mile speed of 12 to 13 knots was considered sufficient for battleships and the largest classes of cruisers. All these vessels possessed good sail power and used it freely as an auxiliary to steam, or as an alternative when cruising or making passages.

When armored battleships were built (1859) the speeds on measured mile trials were raised to 14 or 14½ knots, and so remained for about twenty years. Since 1880 the speeds of battleships have been gradually increased, and in the latest types the measured mile speed required is 19 knots.

Up to 1870 the corresponding speeds in cruisers ranged from 15 to 16 knots. Ten years later the maximum speeds were 18 to 18½ knots in a few vessels. Since then trial speeds of 20 to 23 knots have been attained or are contemplated.

There is, of course, a radical distinction between these measured mile performances of warships and the average sea speeds of merchant steamers above described. But for purposes of comparison between warships of different dates, measured mile trials may fairly be taken as the standard. For long distance steaming the power developed would necessarily be much below that obtained for short periods and with everything at its best. This is frankly recognized by all who are conversant with warship design, and fully allowed for in estimates of sea speeds. On the other hand, it is possible to point to sea trials made with recent types where relatively high speeds have been maintained for long periods. For example, the battleship "Royal Sovereign" has maintained an average speed of 15 knots from Plymouth to Gibraltar, and the "Renown" has maintained an equal speed from Bermuda to Spithead. As instances of good steaming by cruisers, reference may be made to 60-hour trials with the "Terrible," when she averaged over 20 knots, and to the run home from Gibraltar to the Nore by the "Diadem," when she exceeded 19 knots. Vessels of the "Pelorus" class of only 2,100 tons displacement have made long runs at sea averaging over 17 knots. Results such as these represent a substantial advance in speed of Her Majesty's ships in recent years.

Similar progress has been made in foreign warships built abroad as well as in this country. It is not proposed to give any facts for these vessels, or to compare them with results obtained by similar classes of ships in the royal navy. Apart from full knowledge of the conditions under which speed trials are made, a mere statement of speeds attained is of no service. One requires to be informed accurately respecting the duration of the trial, the manner in which engines and boilers are worked, the extent to which boilers are "forced," or the proportion of heating surface to power indicated, the care taken to eliminate the influence of tide or current, the mode in which the observations of speed are made, and other details, before any fair or exact comparison is possible between ships. For present purposes, therefore, it is preferable to confine the illustrations of increase in speed in warships to results obtained under Admiralty conditions, and which are fairly comparable.

A great increase in size has accompanied this increase in speed, but it has resulted from other changes in modern types, as well as from the rise in speed. Modern battleships are of 13,000 to 15,000 tons, and modern cruisers of 10,000 to 14,000 tons, not merely because they are faster than their predecessors, but because they have greater powers of offense and defense and possess greater coal endurance. Only a detailed analysis, which cannot now be attempted, could show what is the actual influence of these several changes upon size and cost, and how greatly the improvements made in marine engineering and shipbuilding have tended to keep down the growth in dimensions consequent on increase in load carried, speed attained, and distance traversed.

It will be noted also that, large as are the dimensions of many classes of modern warships, they are all smaller in length and displacement than the largest mercantile steamers above described. There is no doubt a popular belief that the contrary is true, and that warships exceed merchant ships in tonnage. This arises from the fact that merchant ships are ordinarily described, not by their displacement tonnage, but by their "registered tonnage," which is far less than their displacement. As a matter of fact, the largest battleships are only about two-thirds the displacement of the largest passenger steamers, and from 200 to 300 feet shorter. The largest cruisers are from 100 to 200 feet shorter than the largest passenger steamers, and about 60 per cent. of their displacement. In breadth the warships exceed the largest merchant steamers by 5 to 10 feet. This difference in form and proportions is the result of radical differences in the vertical distribution of weights carried, and is essential to the proper stability of the warships. Here we find an illustration of the general principle underlying all ship-designing. In selecting the forms and proportions of a new ship, considerations of economical propulsion cannot stand alone. They must be associated with other considerations, such as stability, protection and maneuvering power, and in the final result economy of propulsion

may have to be sacrificed, to some extent, in order to secure other essential qualities.

ADVANTAGES OF INCREASED DIMENSIONS.

Before passing on, it may be interesting to illustrate the gain in economy of propulsion resulting from increase in dimensions by means of the following table, which gives particulars of a number of typical cruisers, all of comparatively recent design:

	No. 1	No. 2	No. 3	No. 4	No. 5
Length (feet).....	280	300	360	435	500
Breadth (feet).....	35	43	50	69	71
Mean draught (feet).....	19	18½	22¾	24½	25½
Displacement (tons).....	1,800	3,400	7,400	11,000	14,300
Indicated horse power for 20 knots.....	6,000	9,000	11,000	14,000	15,500
Indicated horse power per ton of displacement.....	3.33	2.65	1.48	1.27	1.09

The figures given are the results of actual trials, and embody therefore the efficiencies of propelling machinery, propellers and forms of the individual ships. Even so they are instructive. Comparing the first and last, for example, it will be seen that, while the displacement is increased nearly eightfold, the power for 20 knots is only increased about 2½ times. If the same types of engines and boilers had been adopted in these two vessels—which was not the case, of course—the weights of propelling apparatus and coal for a given distance would have been proportional to the respective powers; that is to say, the larger vessel would have been equipped with only 2½ times the weight carried by the smaller. On the other hand, roughly speaking, the disposable weights, after providing for hulls and fittings in these two vessels, might be considered to be proportional to their displacements. As a matter of fact, this assumption is distinctly in favor of the smaller ship. Adopting it, the larger vessel would have about eight times the disposable weight of the smaller; while the demand for propelling apparatus and fuel would be only 2½ times that of the smaller vessel. There would therefore be an enormous margin of carrying power in comparison with displacement in the larger vessel. This might be devoted, and in fact was devoted, partly to the attainment of a speed considerably exceeding 20 knots (which was a maximum for the smaller vessel), partly to increased coal endurance and partly to protection and armament.

Another interesting comparison may be made between vessels Nos. 4 and 5 in the preceding table, by tracing the growth in power necessary to drive the vessels at speeds ranging from 10 knots up to 22 knots.

	No. 4	No. 5
10 knots.....	1,500 horse power	1,800 horse power
12 ".....	2,500 " "	3,100 " "
14 ".....	4,000 " "	5,000 " "
16 ".....	6,000 " "	7,500 " "
18 ".....	9,000 " "	11,000 " "
20 ".....	14,000 " "	15,000 " "
22 ".....	23,000 " "	23,000 " "

It will be noted that up to the speed of 18 knots there is a fairly constant ratio between the powers required to drive the two ships. As the speeds are increased the larger ship gains, and at 22 knots the same power is required in both ships. The smaller vessel, as a matter of fact, was designed for a maximum speed of 20½ knots, and the larger for 23 knots. Unless other qualities had been sacrificed, neither space nor weight could have been found in the smaller vessel for machinery and coals corresponding to 22 knots. The figures are interesting, however, as illustrations of the principle that economy of propulsion is favored by increase in dimensions as speeds are raised.

Going a step further, it may be assumed that in unshelved cruisers of this class about 40 per cent. of the displacement will be required for the hull and fittings, so that the balance or "disposable weight" would be about 60 per cent.; say 6,600 tons for the smaller vessel, and 8,500 tons for the larger, a gain of nearly 2,000 tons for the latter. If the speed of 22 knots were secured in both ships, with machinery and boilers of the same type, the larger ship would therefore have about 2,000 tons greater weight available for coals, armament, armor, and equipment.

These illustrations of well known principles have been given simply for the assistance of those not familiar with the subject, and they need not be carried further. More general treatment of the subject, based on experimental and theoretical investigation, will be found in text books of naval architecture, but would be out of place in this address.

SWIFT TORPEDO VESSELS.

Torpedo flotillas are comparatively recent additions to war fleets. The first torpedo boat was built by Mr. Thornycroft for the Norwegian navy in 1873, and the same gentleman built the first torpedo boat for the royal navy in 1877. The reconstruction of the larger class, known as "torpedo boat destroyers," dates from 1893. These various classes furnish some of the most notable examples extant of the attainment of extraordinarily high speeds, for short periods and in smooth water, by vessels of small dimensions. Their qualities and performances, therefore, merit examination.

Mr. Thornycroft may justly be considered the pioneer in this class of work. Greatly impressed by the combination of lightness and power embodied in railway locomotives, Mr. Thornycroft applied similar principles to the propulsion of small boats, and obtained remarkably high speeds. His work became more widely known when the results were published of a series of trials conducted in 1873 by Sir Frederick Bramwell on a small vessel named the "Miranda." She was only 45 feet long and weighed 4 tons, yet she exceeded 16 knots on trial. The Norwegian torpedo boat built in 1873 was 57 feet long, 7½ tons, and of 15 knots; the first English torpedo boat of 1877 was 81 feet long, 29 tons, and attained 18½ knots.

Mr. Yarrow also undertook the construction of small swift vessels at a very early date, and has greatly distinguished himself throughout the development of the torpedo flotilla. Messrs. White, of Cowes, previously well known as builders of steamboats for use on board

ships, extended their operations to the construction of torpedo boats. These three firms for a considerable time practically monopolized this special class of work in this country. Abroad they had able competitors in Normand in France, Schichau in Germany, and Herreshoff in the United States. Keen competition led to successive improvements and rapid rise in speed. During the last six years the demand for a fleet of about 100 destroyers, to be built in the shortest possible time, involved the necessity for increasing the source of supply. At the invitation of the Admiralty, a considerable number of the leading shipbuilding and engineering firms have undertaken and successfully carried through the construction of destroyers varying from 20 to 33 knots in speed, although the work was necessarily of a novel character, involving many difficulties.

As the speeds of torpedo vessels have risen, so have their dimensions increased. Within the class the law shown to hold good in larger vessels applies equally. In 1877 a first class torpedo boat was 81 feet long, under 30 tons weight, developed 400 horse power, and steamed 18½ knots. Ten years later the corresponding class of boat was 135 feet long, 135 tons weight, developed 1,500 horse power and steamed 22 knots. In 1897 it had grown to 150 feet in length, 140 to 150 tons, 2,000 horse power, and 26 knots.

Destroyers are not yet of seven years' standing, but they come under the rule. The first examples (1880) were 180 feet long, 240 tons, 4,000 horse power, and 26 to 27 knots. They were followed by 30-knot vessels, 200 to 210 feet long, 280 to 300 tons, 5,500 to 6,000 horse power. Vessels now in construction are to attain 32 to 33 knots, their lengths being about 230 feet, displacements 360 to 380 tons, and engine power 8,000 to 10,000 horse power.

Cost has gone up with size and power, and the limit of progress in this direction will probably be fixed by financial considerations, rather than by constructive difficulties, great as these become as speeds rise.

It may be interesting to summarize the distinctive features of torpedo vessel design.

1. The propelling apparatus is excessively light in proportion to the maximum power developed. Water tube boilers are now universally adopted, and on speed trials they are "forced" to a considerable extent. High steam pressures are used. The engines are run at a high rate of revolution—often at 400 revolutions per minute. Great care is taken in every detail to economize weight. Speed trials at maximum power only extend over three hours. On such trials in a destroyer each ton weight of propelling apparatus produces about 45 indicated horse power. Some idea of the relative lightness of the destroyer's machinery and boilers will be obtained when it is stated that in a large modern cruiser with water tube boilers, high steam pressure, and quick-running engines, the maximum power obtained on an eight hours' trial corresponds to about 12 indicated horse power per ton of engines, boilers, etc. That is to say, the proportion of power to weight of propelling apparatus is from three and a half to four times as great in the destroyer as it is in the cruiser.

2. A very large percentage of the total weight (or displacement) of a torpedo vessel is assigned to propelling apparatus. In a destroyer of 30 knots trial speed, nearly one-half the total weight is devoted to machinery, boilers, etc. In the swiftest cruisers of large size the corresponding allocation of weight is less than 20 per cent. of the displacement, and in the largest and fastest mail steamers it is about 20 to 25 per cent.

3. The torpedo vessel carries a relatively small load of fuel, equipment, etc. Taking a 30 knot destroyer, for example, the speed trials are made with a load not exceeding 12 to 14 per cent. of the displacement. In a swift cruiser the corresponding load would be from 40 to 45 per cent., or proportionately more than three times as great. What this difference means may be illustrated by two statements. If the load in a destroyer were trebled and the vessel correspondingly increased in draught and weight, the speed attained with the same maximum power would be about three knots less. If, on the other hand, the vessel were designed to attain 30 knots on trial with the heavier load, her displacement would probably be increased about 70 to 80 per cent.

4. The hull and fittings of the torpedo vessel are exceedingly light in relation to the dimensions and engine power. For many parts of the structure steel of high tensile strength is used. Throughout the utmost care is taken to economize weight. In small vessels, for special service, many conditions can be accepted which would be inadmissible in larger sea-going vessels. The result of all this care is the production of hull-structures having ample general strength for their special service. Lightness of scantling, of course, involves small local strength against collision, grounding, and other accidents. Experience proves, however, that this involves no serious risk or difficulty.

These conditions are essential to the attainment of very high speeds for short periods. They resemble the conditions ruling the design of cross-channel steamers, so far as relative lightness of propelling apparatus, small load and light scantlings are concerned. The essential differences lie in the requirements for passenger accommodation as compared with the requirements for armament of the torpedo vessel. No one has yet proposed to extend the torpedo vessel system to sea-going ships of large dimensions. Very similar conditions for the propelling apparatus have been accepted in a few cruisers of considerable dimensions, wherein high speeds for short periods were required. It is, however, unquestionable that in many ways, and particularly in regard to machinery design, the construction of torpedo vessels has greatly influenced that of larger ships.

One important consideration must not be overlooked. For short distance steaming at high speeds economy in coal consumption is of little practical importance, and it is all-important to secure lightness of propelling apparatus in relation to power. For long distance steaming, on the contrary, economy in coal consumption is of primary importance; and savings in weight of propelling apparatus, even of considerable amount, may be undesirable if they involve increased coal consumption. Differences of opinion prevail as to the real economy of fuel obtainable with boilers and engines such as fitted in torpedo vessels. Claims are made for some vessels which represent remarkable economy. Only enlarged experience can settle these questions.

Endurance is also an important quality in sea-going ships of large size, not merely in structure, but in propelling apparatus. The extreme lightness essential in torpedo vessels obviously does not favor endurance if high powers are frequently or continuously required. Still, it cannot be denied that the results obtained in torpedo vessels show such a wide departure from those usual in sea-going ships as to suggest the possibility of some intermediate type of propelling apparatus applicable to large sea-going ships and securing sufficient durability and economy of fuel in association with further savings of weight.

(To be continued.)

THE POLLAK-VIRÁG SYSTEM OF HIGH SPEED TELEGRAPHY.

INTERESTING experiments with the Pollak-Virág system of fast speed telegraphy were made on several

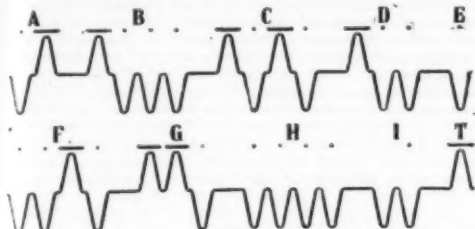


FIG. 1.

nightly lately between Budapest and Vienna, when a speed of from 1,300 to 1,500 words per minute was attained. The tests were made, we understand, in presence of the German technical officials, and a representative of the French government was also present. The following is a technical description of the apparatus:

The transmission is effected by a perforated strip of paper, as in the case of the Wheatstone automatic, and a telephone fitted with two small mirrors serves as the receiver, the diaphragm of the telephone being set into oscillation corresponding to the current impulses gen-

by the light follows a continuous spiral route. The amplitude of the movements of the spot of light are large enough to make the signals clearly legible.

Although this action appears simple enough, allowance has to be made for one important disturbing factor, viz., the natural period of oscillation of the diaphragm itself. This is done by making the duration of each current impulse equal to the natural period of the telephone diaphragm, so that the current always stops exactly at the moment when the diaphragm is swung back to its original position. By

duction, whose dimensions are chosen according to the self-induction, capacity, and resistance of the line.

The first experiments were made through an artificial line whose resistance was 2,000 ohms and capacity 8 to 9 microfarads. These having proved successful, the Hungarian Ministry of Trade kindly allowed tests to be made with four bronze lines of 3 mm. diameter from Budapest to Temesvár. These were connected together at Temesvár, so that a metallic circuit 400 miles long and of 4,000 ohms resistance was obtained. The experiments made both in

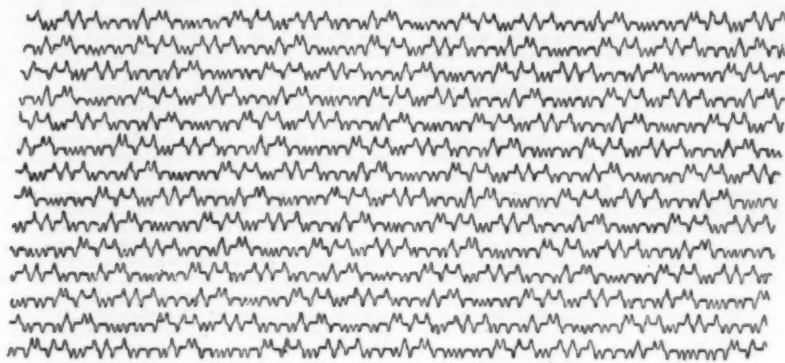


FIG. 2.—REPRODUCTION OF A SAMPLE RECORD.

suitably adjusting the velocity of the paper and the dimensions of the perforations, the duration of an impulse can be regulated, and a perfect damping of the membrane so obtained. But in order not to be dependent in practice on the precision of the movement of the paper, another device has been added. If the current impulse is shorter than the natural period of the vibration of the diaphragm, and a condenser is connected in parallel to the telephone, this condenser will be charged during the duration of the current impulse. After the current ceases, the condenser (as

wet and dry weather, and a speed of 70,000 words per hour, and 20 volts battery pressure, gave clear signals, while with 25 volts a speed of 100,000 words per hour was attained. Other experiments on a metallic circuit of iron wire 210 miles long and of 6,000 ohms resistance were also successful, a speed of 54,000 words per hour being obtained with a 60-volt battery. In the experiments the perforated strip was fastened on a drum in such a way that the same series of letters were constantly repeated. We have referred above to the most recent trials between Budapest and Ber-

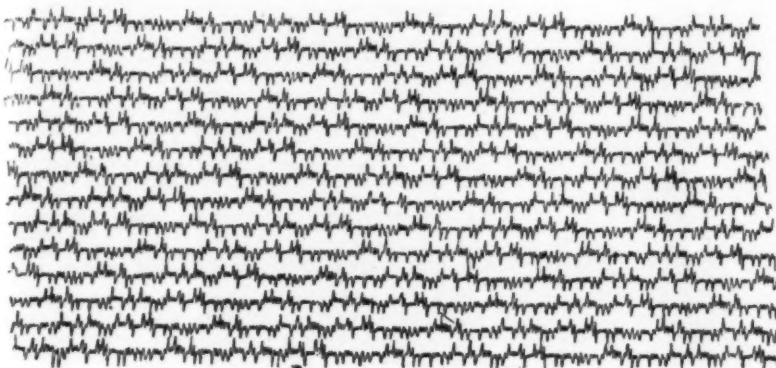


FIG. 3.—DAMPING DEVICE OMITTED.

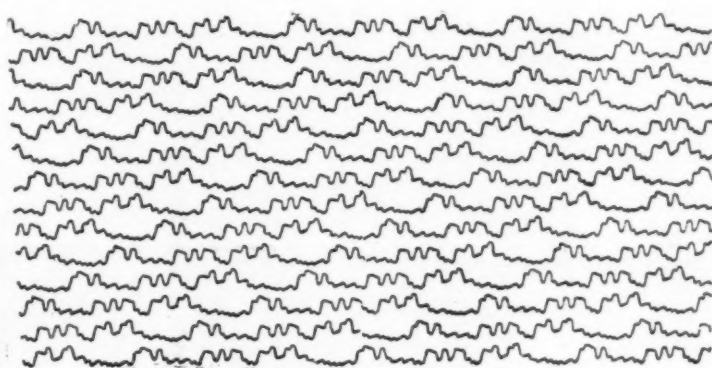


FIG. 4.—INDUCTIVE BRIDGING COIL OMITTED.

erated by the transmitter. These oscillations are made visible photographically. The dots and dashes of the Morse code are represented by strokes on either side of the central line, as shown in Fig. 1, the strokes being produced by current impulses in different directions. The transmitting apparatus, *B*, Fig. 5, consists of a roller driven by a motor or clockwork. This roller moves the perforated paper forward, and is connected with the line. The strip of paper is perforated in two lines corresponding to the two directions of the current, and above it two brushes are fixed, one connected to the positive pole of one battery, the other to the negative pole of another. The return wire is connected with the other two poles of the two batteries. Now if in consequence of the perforations of the paper one of the two brushes comes into contact with the metal roller, a positive or negative current flows through the roller to the line and thence to the receiving apparatus.

At the receiving station, *B*, the currents, as already mentioned, pass through a telephone whose diaphragm is moved in a direction determined by the direction of the current impulse. The movements of the diaphragm are transmitted to a small mirror with the assistance of a metal rod. It is necessary that the small movements of the diaphragm should occasion a relatively large displacement of the mirror. This is done by fastening to the mirror a small plate of soft iron, held in position by one pole of a permanent magnet. The pole of the magnet ends in two points, and holds the mirror in such a way that the line joining these two points is the axis about which the mirror turns. The other pole of the magnet is provided with a weak spring, also ending in a point, and forming the third point of support of the mirror. This spring is now connected to the diaphragm by means of a small rod, so that the small movements of the diaphragm cause a rotating motion of the mirror, which is relatively large, as the points of support of the mirror are very near to one another. This method of magnifying the movements of the diaphragm has the advantage that, in consequence of the small weight of the moving parts, the velocity of vibration of the diaphragm is not lessened. The light of a small glow lamp falls on the small concave mirror just mentioned, which throws the image of the filament on a piece of paper sensitive to light. In front of this sensitized paper a cylindrical lens is placed which draws together the long narrow image to one bright point. In consequence of the current impulses which move the diaphragm and mirror, the spot of light moves out of its original position in one direction or the other. In this way the up and down strokes already mentioned are traced on the sensitized paper. The latter is wound on a drum which is mounted on a screwed spindle, so that the line traced

shown in Fig. 6) discharges into the telephone circuit, and prolongs the duration of the current. By using a condenser of suitable capacity, it is contrived that the diaphragm returns to its original position without first oscillating to and fro.

It appears that the inventors have not overlooked the fact that the properties of the line, independently of the apparatus, render fast speed telegraphy difficult. An endeavor is made to counteract this influence to some extent by connecting, parallel to the line at the transmitting station, a coil with self-in-

ductance, which are stated to have given distinct and readable signals at speeds of from 1,300 to 1,500 words per minute. Fig. 2 is a reproduction on a reduced scale of the signals received, Fig. 3 shows the same series of signals without the device for damping the oscillations of the diaphragm, and Fig. 4 shows the disturbing effect of the line itself when the self-induction coil is omitted. The time taken to receive such a sheet with 500 to 600 words is stated to be 22 seconds. We are indebted to The London Electrician for the above interesting facts concerning this system.

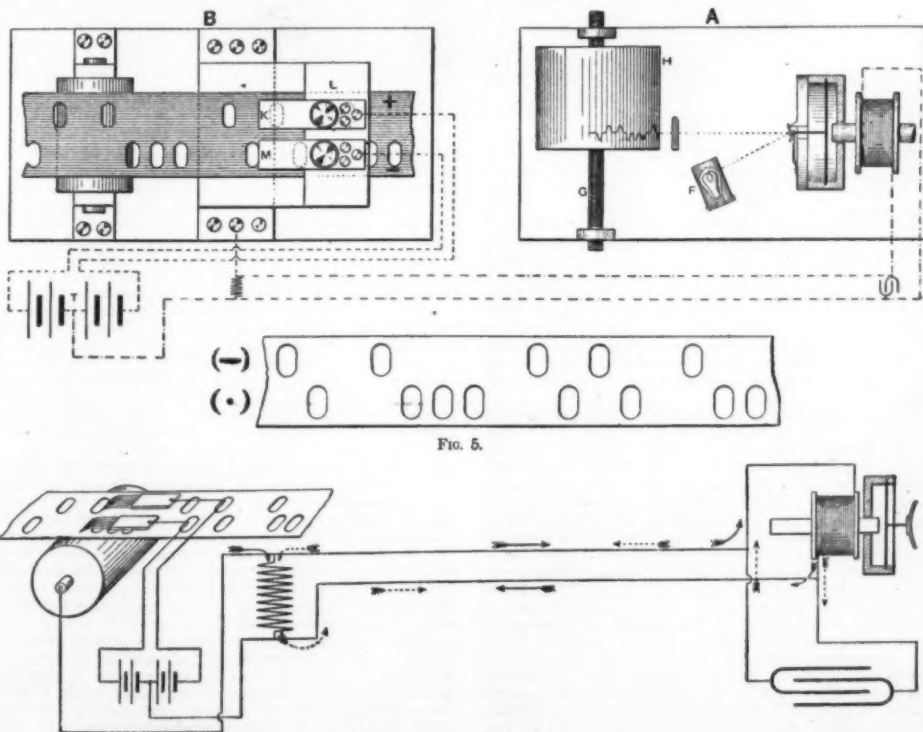


FIG. 5.

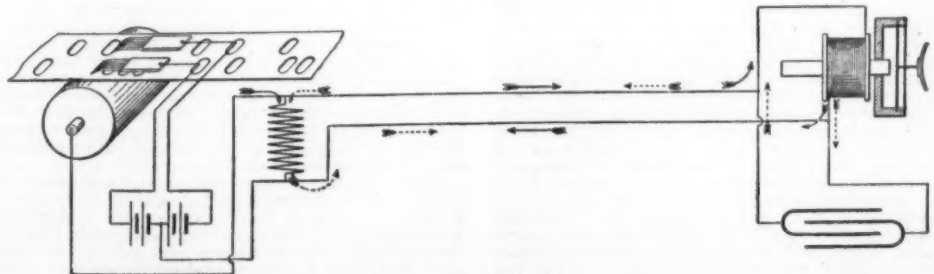


FIG. 6.

TEST OF THE MARCONI WIRELESS TELEGRAPHY IN THE UNITED STATES NAVY.

The subject of wireless telegraphy has been brought prominently before the American public during the past few weeks in connection with the races that were held for the America's cup. The desirability of reporting the progress of the races, from hour to hour, as they took place over the course of the New York Yacht Club outside New York Harbor, suggested to a leading New York journal that the Marconi system of wireless telegraphy might be used to advantage for this purpose. The Marconi apparatus was installed on a large ocean-going steamer which accompanied the yachts over the course, and another set of apparatus was carried on the cable steamer "Mackay-Bennett," which was anchored near the Sandy Hook lightship, the starting and finishing point for the competing yachts. A third set of apparatus was placed at the Navesink lighthouse on the New Jersey shore. Mr. Marconi, who was in the operating room of the steamer which accompanied the yachts over the course, was enabled in this way to report at every few minutes' intervals their respective positions. The messages flashed out from the vertical wire on the ship were received by the "Mackay-Bennett," and at the Navesink lighthouse. The "Mackay-Bennett" had temporary cable connection with New York, and thus the progress of the races was reported continuously throughout the world.

At the close of the yacht races, the Marconi apparatus was transferred to the armored cruiser "New York" and the battleship "Massachusetts," which put

a small closed glass tube called the coherer into which are lightly fitted two silver pole pieces, whose ends are about one-fiftieth of an inch apart, the space between them being filled with fine nickel and silver filings with just a trace of mercury. The other ends of the pole pieces are attached to the wires of a local circuit, and also one to the vertical wire and the other to earth.

Normally the filings constitute a practical insulator, but when they are influenced by the Hertzian waves they cohere, and the resistance falls, allowing the local current to pass. Coherence continues until the filings are shaken, when the insulation is established and the current broken. When the Hertzian waves are thrown out from a distant vertical wire by the depression of the key of the sender, as explained above, they are received by the vertical wire of the receiver and coherence takes place. Mr. Marconi has devised an ingenious arrangement in which a hammer is made to rap continuously upon the coherer by the action of the local circuit, which is closed when the Hertzian waves pass through the coherer. As soon as the waves cease, the hammer gives its last rap and the tube is left in the de-cohered condition, ready for the next transmission of waves. It can readily be seen that by making the local circuit operate a relay, in the circuit of which is a standard recording instrument, the messages can be recorded on a tape in the usual way.

Mr. Marconi's valuable work has been done in two directions: First, in perfecting the coherer and rendering it amenable to the manipulation of the Morse code; secondly, by discovering and formulating the laws which govern the relation between the height of

upon the tape as long as the sending key is depressed. Hence, applying this description to the yacht races, our readers will understand that by the manipulation of the sending key on the "Grande Duchesse," which followed the competing yachts over the course, the operator was able to produce the dot and dash characters of the Morse code on the tape of the recording instrument on the "Mackay-Bennett," many miles distant.

In carrying out the experiments between the "New York" and the "Massachusetts," the former ship was stationed at Sandy Hook lightship while the "Massachusetts," steamed off to sea, messages being sent continuously between the two vessels. The transmission was successful up to a distance of thirty-six miles on the "New York" and forty-five miles on the "Massachusetts," beyond which the messages became undecipherable. This distance does not by any means represent the full capacity of the system, for during the autumn maneuvers of the British navy messages were dispatched between warships which were eighty miles from each other. Even more remarkable than this was the successful test carried out over both land and water between Chelmsford, in England, and Boulogne, in France, a distance of one hundred and ten miles. On this occasion the electrical surges were transmitted successfully through solid obstacles, such as the range of chalk hills known as the South-downs, and, moreover, there was the obstacle presented by the curvature of the earth in this distance.

As to the future of Marconi telegraphy, it is probable that its sphere of usefulness will be found chiefly in naval and military operations. It will no longer be necessary for a scouting vessel to keep within signaling distance of the fleet, nor will it be possible for the enemy in land operations to sever communication by the simple work of cutting the telegraph wires. A beleaguered city, such, for instance, as Ladysmith, in South Africa, would be able to communicate with the outside world without the slightest risk of interference by the enemy and, indeed, without the enemy's knowledge.

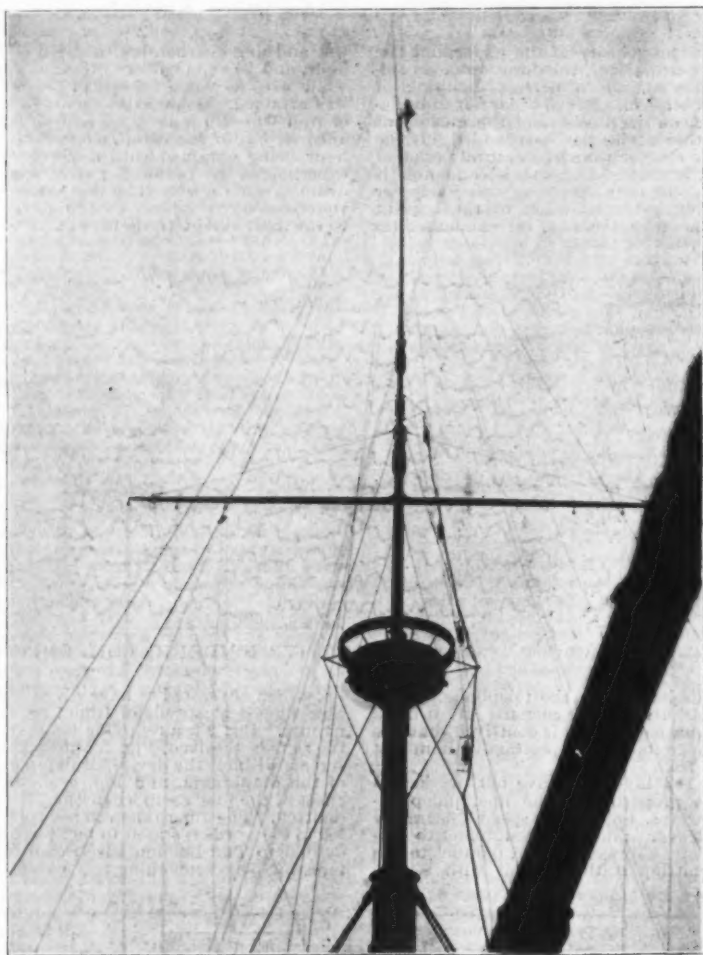
BORING FOR GAS AND PETROLEUM IN CHINA.

The province of Se-Tcheou, one of the largest divisions of China, is bounded on the west by Tibet, on the south by the provinces of Yun-nam and Kong-tcheou, on the north by Chan-si and Kan-si, and on the east by Fou-lan and Fou-pe, says The Petroleum Industrial and Technical Review. The whole of the province of Se-Tcheou is almost surrounded by hills, and the chief town, Tchen-tou, lies in a valley. The mountainous district is stated to be very rich in mineral deposits, the lowland provides good cultivable soil, while a large number of petroleum wells and natural gas springs are known to exist here. The district is fed by a small stream, which divides it into two parts. On the left side of this stream lies Fou-choen, and on the right side the city of Ouan-hein. The chief petroleum district is about 100 ly from the city, and approximately occupies only 300 square kilometers. The largest natural gas well is close to the mountain range called Tse-liou-tsin, and by this name the well also is known. It is one of the oldest wells in existence.

Before reaching the petroleum lands the city of Louy-kiang is passed, the country surrounding it being of the most fertile description and producing rice, maize, pease, and also sugar-cane. This state of things continues for some ten miles or so, when the character of the soil suddenly changes, and there is nothing to be seen but yellow sand, chalk, and lime. It is here that the gas wells are situated. The whole district is covered with derricks, and the sound of escaping gases is heard; the atmosphere is saturated with salt, sulphureted hydrogen, and various other gases. The activity shown by the Chinese in this district and the primitive appliances with which they obtain the valuable deposits are very remarkable. The buildings, the methods adopted, and the tools employed are of the simplest. That the Chinese are able to achieve what they do is only due to their marvelous patience and perseverance. The configuration of the country indicates that it is of volcanic origin, and that it has been twice visited by volcanic eruptions. This explains the irregular character of the strata and the differences in the depths of various wells which are sunk close together. There are wells which give only salt water, others which yield petroleum, and others which give natural gas. Some wells exist also which yield salt, water, and petroleum, and a few giving salt and gas. Most of the salt water is obtained at a depth of from 930 to 1,000 meters, and these wells are the most productive for petroleum gas.

In laying down a boring the Chinese naturally have to rely entirely on guesswork. They themselves state that a reliable indication is provided by the vegetation, the smell of which shows whether there is salt or gas or petroleum present. The consequence of this haphazard method of going to work is necessarily a large number of failures, as well as the ruin of those engaged in the enterprise. . . . The work is commenced by the removal of the ground to the extent of some few feet in diameter. Stones met with are drilled through and then removed in baskets. The stones used are about two or three feet square, in the center of which a hole is bored thirty centimeters in diameter. They are placed one above the other and cemented together with lime. This preliminary preparation represents the pipe, and when this is ready the actual boring takes place. The boring device consists of a central beam of very hard wood, having on each end an iron cap, which is placed in an iron groove in which it revolves. If we take into consideration that with this primitive arrangement it is possible to bore to a depth of 1,100 meters, it will easily be recognized what an enormous amount of labor must be expended upon what are really very small results.

The petroleum obtained from the wells is of four different qualities. The first is of a very light color, and is used in its natural state for burning with petroleum refined in special lamps; the second is of a greenish color and is less valuable than the first; the third is of a yellow color, and the last is black, thick and viscous. The oil first mentioned is also employed by the Chinese for medical purposes for various diseases, especially for skin diseases and rheumatism. At the time this report was written there were under exploitation about forty



MAST OF THE "NEW YORK," SHOWING THE VERTICAL WIRE.

to sea for the purpose of subjecting the system to a thorough and systematic test. Our illustrations, which were taken during the progress of the trials, show the installation as carried out on the "Massachusetts," the apparatus employed on the two vessels being precisely similar. In each case an auxiliary mast was lashed to the topmast in order to give the requisite vertical height for the wire. The wire was attached at its upper end to a small yard carried on the auxiliary mast, and led down to the operating room, in which were placed the receiving and sending apparatus. The wire was connected with both the receiver and the sender, and each of these was connected to ground, this being done by making connection with the metal structure of the ship.

The sender consists of a powerful induction coil in the primary circuit of which is a Morse key, while the secondary circuit ends in a radiator composed of two metallic spheres. Every time the key is depressed and a spark passes between the spheres, electromagnetic waves of extremely high frequency are thrown out through the air from the spheres, and more particularly from the vertical wire, which reaches, as we have shown, from the sender to the top of the mast. These electrical waves are transmitted through space in exactly the same way as light and obey the same laws, and they are thrown out into space as often and as long as the Morse key of the sender is depressed. Hence it only needs a suitable receiver and recorder to enable messages to be transmitted and received by means of the ordinary dot and dash code. According to Mr. Marconi, a suitable receiver was first discovered by Prof. Onesti, and after modifications by Branly, Lodge and others, was brought to its present perfection by Mr. Marconi himself. The receiver consists of

the vertical wire and the distance at which its outflowing waves may be received and recorded. This he has ascertained to vary as the square of the vertical height of the wire, measured from the top of the wire to the level of the transmitter and receiver below.

To assist our readers to a clearer understanding of the Marconi apparatus, we have included the accompanying diagram, of which the following is a description: The letters, *d*, *d*, indicate the spheres of the transmitter, which are connected, one to the vertical wire, *w*, the other to earth, and both by wires, *c*, *c*, to the terminals of the secondary winding of induction coil, *c*. In the primary circuit is the key, *b*. The coherer, *j*, has two metal pole pieces, *j*, *j*, separated by silver and nickel filings. One end of the tube is connected to earth, the other to the vertical wire, *w*, and the coherer itself forms part of a circuit containing the local cell, *g*, and a sensitive telegraph relay actuating another circuit, which circuit works a trembler, *p*, of which *o* is the de-cohering tapper or hammer. When the electric waves pass from *w* to *j*, *j*, the resistance falls, and the current from *g* actuates the relay, *n*, the choking coils, *k*, *k*, lying between the coherer and the relay, compelling the electric waves to traverse the coherer instead of flowing through the relay. The relay, *n*, in its turn, causes the more powerful battery, *r*, to pass a current through the tapper, and also through the electromagnet of the recording instrument, *h*.

The alternate cohering by the waves and de-cohering by the tapper continues uninterruptedly as long as the transmitting key at the distant station is depressed. The armature of the recording instrument, however, because of its inertia, cannot rise and fall in unison with the rapid coherence and de-coherence of the receiver, and hence it remains down and makes a stroke

gas wells. The temperature of the petroleum and salt water as it comes from the wells is about 250 degrees Cel., while the temperature of the atmosphere is only about 40 degrees Cel.

Natural gas is principally used for concentrating the salt water, but very seldom for illuminating purposes. This gas is of two descriptions, namely, that obtained at a depth of from 75 to 150 meters gives a white flame and is only found in small quantities, and that from a depth of 670 meters, and escaping under great pressure, is very rich in hydrogen, and burns with a blue flame and produces a very high temperature. It also contains silver points, and is obtained in large quantities.

The opening of a gas well in a new district very seldom takes place without a number of accidents happening to the workmen. They are extremely careless in boring, and adopt few precautions until the moment they have reached the strata from which the gas escapes, and in most cases the gases escape with such force that all the boring tools are hurled high into the air, injuring everyone who is near at hand. Many of the wells constantly catch fire and explosions occur in every direction. When a fountain catches fire, the heat is so great that the whole of the surrounding land is cracked and the surface for about 100 to 120 feet is one mass of flames, the flames sometimes rising to a height of 60 and 70 feet. Such a fire is seen for many miles round, and one such fountain was burning for a whole year, the natives being unable to extinguish it. The method adopted for putting out these fires is as follows: Round the burning wells they build an earthen

comes into the furnace under pressure, which causes a great noise. The bamboo pipes are joined together by a special mastic, and by this means the gas is delivered to the furnace. In this primitive arrangement there does not exist a single valve to control the gas. When the gas is not needed the light is merely blown out, and the gas is left escaping, consequently the atmosphere becomes full of sulphureted hydrogen and acts very injuriously on the workmen. The results in fact have been so bad that they decided to work by day only. They also introduced a special arrangement whereby the gas was conveyed to the outside of the works, where it is continuously burning, the flames rising sometimes to a height of 6 and 7 meters.

THE FROZEN DEPOSITS OF THE NORTH.

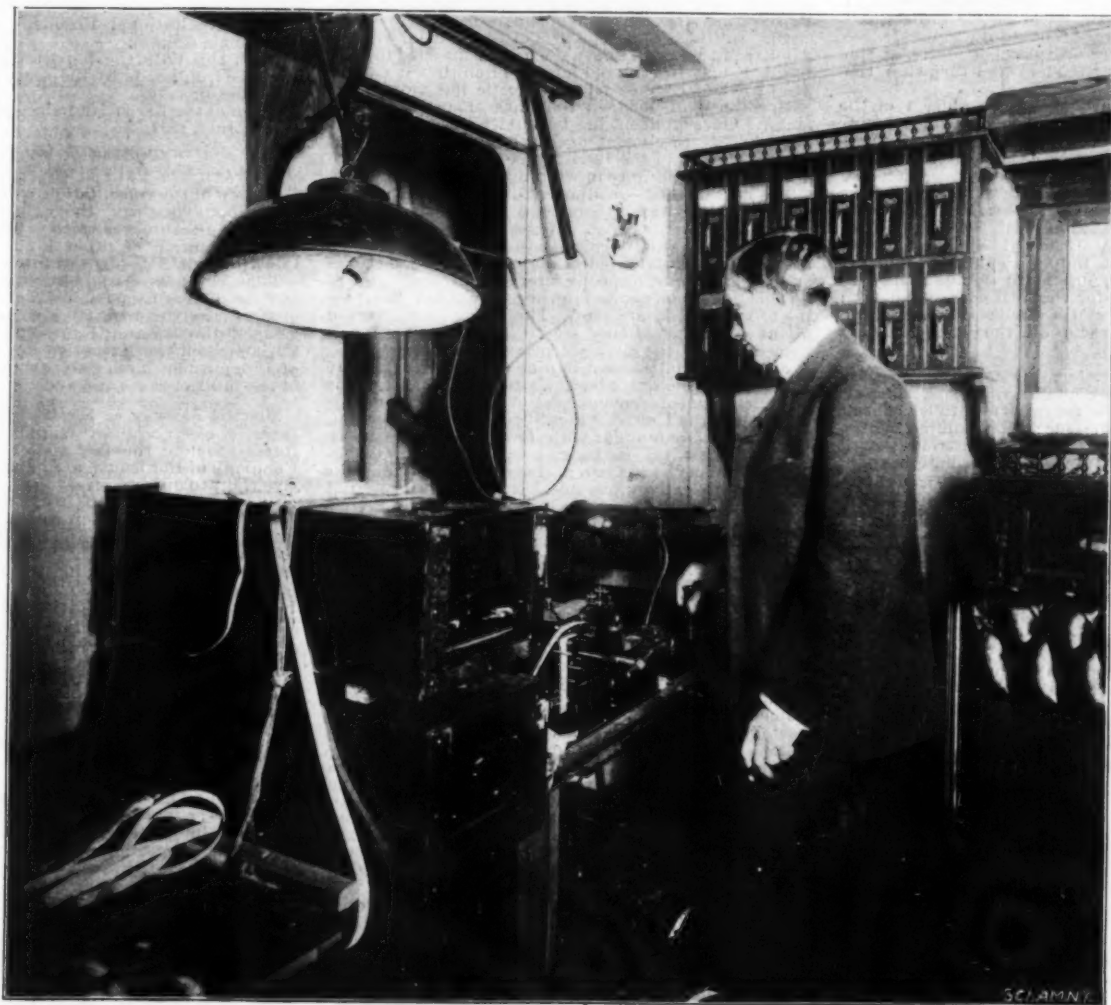
The correctness of the theory that the depth of unvarying temperature increases from 1 foot at the equator to 70 odd feet at the poles, has been called into question by a shaft having been sunk over 1,500 feet in the sediments of northern Siberia without reaching the limit of frost and by the great depths to which frost extends in the Klondike. But while these facts are indisputable, they do not contradict the theory as much as they appear to at a first glance.

A further investigation of the facts of the case shows that in some localities where frost extends to great depths, there are places where the frost limit is reached in a few feet; that frost only extends to great depths

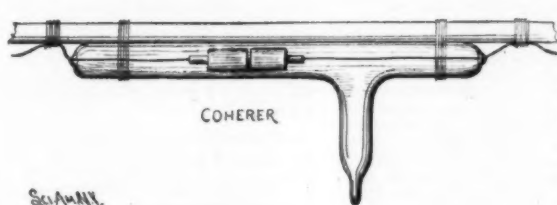
The key to the solution lies in the fact that the localities in which the frost reaches depths much greater than those called for by the theory are situated in sections which are or were favorable for the accumulation of slides, sediments, etc., while the places in or near them situated unfavorably for such accumulation are only frozen to comparatively shallow depths. From this it is evident that instead of having been frozen to those immense depths by an intense degree of cold, the deposits were gradually frozen as they were formed. In other words, instead of having been frozen from the top down, they were frozen from the bottom up as they were formed by overlaying. In proof, then, that this process is still at work, and quiet and slow though it be in its operations, it is amply able to do all that has been done in that line of freezing without any unusual degree of cold.

At present the Klondike affords the best facilities for the study of the interesting phenomena attending the process of freezing from the bottom up. This is partly on account of the data furnished by the mining operations and partly because the easily decomposed schists of that section render the process more rapid than among harder formations. Although the process can be traced in all the valleys and low places, it is seen to the best advantage where the effacing hand of Nature is rebuilding, from the bottom up, the portions of the frozen deposits which have been mined out.

The process of freezing from the bottom up is practically as follows: The winter's freezing extends to a certain depth; the spring thaw, rains, etc., bring down



OPERATING ROOM ON THE "MASSACHUSETTS," SHOWING THE MARCONI RECEIVING AND SENDING APPARATUS.



THE COHERER.

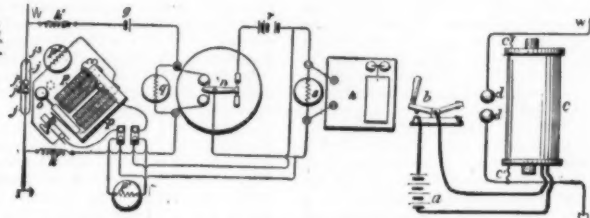


DIAGRAM OF THE TRANSMITTER AND RECEIVER.

wall which is constantly watered. Another wall is erected round this a few feet away, so that a reservoir is formed round the fire. The workmen then fill in this space between the two walls with water. When this is done, they break an opening through the inside wall, and the water rushes through and extinguishes the fire.

It is interesting also to notice how the Chinese make use of the gas obtained from the wells. Near every well a pit about 6½ meters deep is dug out, in which they fix a clay pot turned upside down. In this pot is an opening through which a wooden pipe is inserted for the gas to pass through. This is the form of the first gas holder in existence. The gas is then conveyed through bamboo pipes to the next gas furnace, and is eventually led into what are feeding tanks, over which are the evaporating pans containing salt. The gas

in deposits which are either composed of sediments or the accumulations of a series of slides, while the places in which frost only extends to shallow depths are so situated that they cannot be overlaid by surface deposits to any depth. Again, in consideration of the shallow depths to which ground is frozen by months of temperatures ranging from 10° to 60° below zero, the degree of cold necessary to freeze to the depth at which the search for the frost limit was abandoned in Siberia would leave an indelible imprint upon the rest of the earth, but thus far no such evidence has been discovered, as it would be a vastly greater degree than that requisite to produce any glacial epoch whose traces are discoverable at the present day. Furthermore, such a degree of cold would not freeze adjoining places to such varying depths when the rates of conductivity of their formations are practically identical.

the annual contribution of slides, sediments, etc., from the higher ground, before the ground is thawed very deep, and protects it by overlaying so that the summer's thaw fails to reach the limits of the winter's freeze. The cold of the ensuing winter usually freezes down to the old frost, but in cases where the season's accumulations are too great for that, they gradually become frozen by the excess cold surrounding them, as the temperature of the frozen deposits is considerably below the freezing point.

On account of the great depths to which the vast alluvial plains and tundras of the North are frozen, they were evidently formed during a period of subsidence, when the sediments kept the surface near the water level while the underlying formation was sinking.—Asa Thurston Heydon, M.E., in Mining and Scientific Press.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Railway Bridges in India.—In the interest of our bridge manufacturers, I would call attention to the following correspondence, in reference to bridges about to be contracted for on the Southern Mahratta Railway, British India, says Rufus W. Patterson, United States Consul-General at Calcutta:

On July 8 last, I wrote to the Honorable Secretary to the Government of India, public works department: "I am informed that several large iron or steel bridges will be contracted for on the Southern Mahratta Railway, and I have the honor to ask if proposals for the work will be entertained from the iron and steel manufacturers of the United States. If so, will you kindly furnish me the necessary specifications, so that they may have an opportunity to bid for the contract?" "In this connection, I will call your attention to the fact that contract for the Atbara bridge across the River Nile was secured by one of our manufacturers in fair and open competition with English and other contractors; and by permitting the manufacturers of the United States—who have the most improved facilities for doing such work on a large scale—to enter into competition for the work, money may be saved to the government."

The following answer has been received: "With reference to your letter dated Calcutta, July 8, 1899, I am directed to inform you that stores for the Southern Mahratta Railway Company, as for other railway companies, are got out through their home boards on the advice of their consulting engineers, as per list attached; and that contracts for girders and iron work for state railways worked by the state are arranged for by the director-general of stores, at the India Office, who calls for tenders and furnishes the necessary specifications."

The following are the consulting engineers of the various railways of India, with whom our bridge manufacturers should correspond if they desire to bid for contracts that may be in contemplation, viz: Sir A. M. Rendel & Son, 8 Great George Street, Westminster, London, S. W., for the Indian state railways, East Indian Railway, Bengal and Northwestern Railway, Southern Mahratta Railway, and Bengal Central Railway; Sir George A. Bruce, 3 Victoria Street, London, S. W., for Great Indian Peninsula Railway, Indian Midland Railway, and South Indian Railway.

It would also be well for them to correspond with the director-general of stores, India Office, London, with reference to contracts on the state railways worked by the state.

A Suggestion to Exporters.—Consul Tourgée, of Bordeaux, under date of September 16, 1899, suggests that it would be advisable for exporters to let consuls know something about the success or failure of enterprises in which they engage in their districts. As it is now, he says, they write asking information about dealers, opportunities, etc. The consul writes perhaps a score of letters to get the information they want, tells them what they must do, and then hears nothing more from them. It is impossible for him to learn what is done or being done along the lines he has recommended. The French authorities report importations in a manner so different from our own, that reliable comparison is literally impossible. Mr. Tourgée adds:

The French dealer is suspicious itself. He thinks anyone who asks about his business is an enemy, and the American exporter apparently imagines the consul has no interest in his business until his help is needed to collect a bad debt, which might never have been incurred if the consul had been informed with whom he was dealing and been asked to have an eye on his affairs. In my opinion, a consul is worth twice as much in looking after an enterprise already begun as in advising as to its institution.

Extension of American Trade in Russia.—Parties in New York State have written to this office requesting certain information relative to the best means for the enlargement of trade in Russia, and inasmuch as it is of a character to interest all American merchants who are trying to export, I send my reply to the Department, says J. C. Monaghan, Consul at Chemnitz.

The questions asked deal with Russia, the possibilities of increasing trade in or introducing American goods into that country; if it is advisable to put catalogues for distribution in Russia in French or German, and if catalogues in French would be worth anything for distribution in Germany. They ask also for such facts and information regarding Russia as I am able to add.

There are many ways of doing business, but there are not many that excel those employed at home. The best way to build up a successful export trade is to carefully go over the ground to be covered, studying it in its minutest details. To do this well, an expert is almost indispensable. By expert I mean a man familiar with the goods to be sold, their qualities, application, etc. Consuls can never hope to do more than point out opportunities in a general way. This they do quite successfully. The man who goes out to survey the ground should, if possible, speak the language of the people he is to study. This is not, however, an absolute necessity. What is wanted most at first is a man of brains to go over the territory, studying its wants, possibilities, etc. Export trade differs from the home trade in this: At home, we know the people with whom we are to deal; in export trade we do not. This is a much more important factor than appears at first glance. Foreigners are affected by prejudices, and it is wrong to laugh at these prejudices. They must be overcome, and consuls can be of incalculable service in pointing out how best to overcome them. Our merchants must make up their minds to adapt themselves to the business methods of the people among whom they want to sell. This is law and gospel for those trying to win foreign markets.

After going over the ground and finding a good field, the next step is to learn conditions of sale, whether goods can be sold for cash or on what time. Russia, because of the old system under which goods were bought at the annual Nishni Novgorod fairs, will demand long terms in which to make payments. This has changed to some extent, but in most parts of the empire one will still find the long term system in vogue; hence, anyone wanting to do business with

Russia must be prepared to wait six months or more—in many cases a year—for his money, nor will liberal discounts for cash do away with more than a very small percentage of these periods.

The next point is the kind of money to be paid, whether it is fluctuating or liable to fluctuate. Credits must be studied. In a country where so much business is done on long credits, one would imagine that a system like Dun's or Bradstreet's would be adopted. I regret to say that the system in Russia is very far from perfect, although it is fast improving.

The next step is how best to bring goods to the notice of those to whom it is desired to sell. Some goods speak for themselves, others have to be spoken for. There are several methods that may be successfully used to make goods known in the market. The best, undoubtedly, is to open a branch house, but that is very expensive; the next best plan, and one that commends itself because of its cheapness, is the employment of a resident agent, one who can give all his time to the business. A good plan is to pay him entirely or in part on commission. Next to this, and still cheaper, is to get agents already doing business in the districts to handle the goods. These "general agents" must be watched, however, as they have been known to suppress goods of one firm for the purpose of favoring a rival. A good plan would be for half a dozen or more houses to combine and send out a reliable man to represent them, allowing him to sell partly on commission and partly on salary. Half a dozen hardware houses, half a dozen or more paint, oil, and varnish makers could do this, taking care to get no conflicting parties connected with the same man. In selecting agents, too much care can not be exercised. In the first place, a firm of young men, without a dollar in the world above the capital invested in their business, may beat an old house so rich that it cannot keep track of its possessions. Hustle has more to do with success in business than has almost any other factor. Once an agent has been selected, give heed to his advice. Intelligent agents ought to know best what is wanted in the territory covered. A little liberality goes a long way in winning new markets.

The next method—sending catalogues—is the poorest of all, and I hesitate to commend it. Still, it has one or two things in its favor. Parties interested in getting out catalogues will, of course, study the field in which they are to be distributed. Catalogues serve sometimes as advance agents, arousing interest, but they always do this best when printed in the language of the people to whom they are sent. The thing most needed about catalogues, if they are to be useful, is oftenest neglected, viz., the giving of prices. Catalogues lacking this essential element in nine cases out of ten are consigned to the waste-basket. In cases that call for the metric measurements do not give measurements common in the United States. This is very important. Few people are familiar with foreign weights, measures, etc. Let the language accompanying drawings or illustrations be so plain and so simple that a mistake will be practically impossible. It will be wiser to put catalogues intended for distribution in Russia in French than in German, for almost all educated Russians read, write, and speak French; and catalogues printed in French can, and no doubt will, be read in Germany. Of course, it will pay much better to put catalogues into the language of the land in which one intends to sell.

There are half a dozen "don'ts" that are well worth heeding. Don't abbreviate. Who over here is familiar with English abbreviations? Don't neglect your correspondence; it pays to answer letters promptly upon receipt, if only to say: "Yours received; will give it immediate attention." Don't fail to find out foreign postage laws or regulations and comply with them, always making sure to put on enough stamps to carry letters or samples to their destination. It is the custom in most countries to collect double postage on letters lacking the necessary amount. Put important letters beyond the peradventure of miscarriage. Don't mix up discounts, terms of payment, etc. Try to have everything clear before the first shipment is made. Don't have goods of a quality below samples. Packing is a very important factor; don't pack as if you never expected to sell another bill of goods. Herein the Germans excel, and it pays. There are few things more exasperating than to wait a long time for an article and have it come unfit for use. Don't, after you have gone to the trouble of picking out an agent, be forever doubting his honesty. He may find it necessary to do expensive things, and you may find that these pay. Don't expect too much the first year. The public has to find out the advantages of your goods. Don't despair if you don't do as much the first six months as you expected. It takes time to win a way in new, unknown, and hitherto untrodden markets. If you give a man a good field to operate in, don't discourage his efforts by dividing the territory into small, non-paying parcels. Don't hesitate to consult consuls, who are nearly always well posted as to the possibilities of their districts. Don't fail to advertise in the best export papers of our own and other countries. It pays. Don't neglect the export organizations which are doing so much to make our manufacturers known abroad. Don't put off till to-morrow what should be done to-day. The export trade is growing more and more important, and we must go on and out or shut up a great many shops. Do what other successful nations are doing to get foreign markets, but do it first, if possible.

Russia has many points of resemblance with the United States. It must not be forgotten that Germany has already gained a very important position—in fact, a commanding one—in Russian trade. Not only has she large amounts of capital invested, but she has a large number of her people there. The banking business is very largely in German hands or under German influence. Many of the mills now being built all over Russia are going up under German directors and are being paid for with German capital. German weavers and spinners are exploiting the entire empire. It is time for us to take a hand.

The field opened to us is enormous. Russia will want for a long time the same kinds of tools, implements, and machines as we have used. It has mines to open, oil fields to drain or exploit, forests to cut down, mills to build, roads, railroads, and bridges to construct. All kinds of time and labor-saving machines will be wanted. One ounce of effort put into

Russia will yield better results than tons in Germany and other parts of this old continent. Germany, Belgium, France, England—all of them—are aiming for the same goal—a foothold in Russia. An effort now, before the important parts are all taken, will pay much better than later on. The disposition of Russia toward our people is very favorable.

Telegraph to Dawson.—Under date of September 22, 1899, Consul Dudley, of Vancouver, informs the department that the telegraph line from Skagway to Dawson has been completed and is now in operation. The nearest point to Skagway reached by telegraph, adds the consul, is Cumberland or Comax, British Columbia. It is stated that arrangements will be made for steamers to call at Comax to deliver messages brought from Skagway and on their north-bound trips for messages to be delivered at Skagway. This places Dawson within about two and one-half days by telegraph. Mr. Dudley has also been informed that officers are at work surveying a line from Ashcroft, on the Canadian Pacific Railway, via Quesnelle, British Columbia, to Telegraph Creek, in the valley of the Stikine River. As soon as the survey is completed, it is expected that a telegraph line will be constructed: a branch line to Atlin, British Columbia, from Lake Bennett will also soon be in operation.

Guatemalan Duties on Cattle and Tobacco.—Consul-General Beaupré, of Guatemala, under date of August 3, 1899, transmits copy of decrees concerning the importation of cattle and tobacco, as follows:

DECRETE NO. 600.

The Constitutional President of the Republic of Guatemala decrees:

From this date the importation of cattle, whether over the frontiers or by the seaports, will be free from all duties or taxes.

Given at the Executive Palace in Guatemala the 29th day of July, 1899.

IMPORTATION OF TOBACCO.

NATIONAL PALACE, GUATEMALA, July 28, 1899.

In view of the consultation with the collector of customs about equalizing the importation duties on leaf and manufactured tobacco, with what is charged for the importation of other kinds of merchandise, the Constitutional President of the Republic decrees:

That for leaf or manufactured tobacco imported from the 1st of August next by the seaports there will be charged, in the respective custom houses, the additional duties of 7 and 15 per cent. over the tax that the 8th article of the Executive decree No. 596 of the 9th of June ultimo; having to pay in gold the 10 per cent. of the total of taxes and additional duties.

Electric Railway in Bordeaux.—American manufacturers of electric railway supplies may find it to their interest to note the fact that the Tram and Omnibus Company of Bordeaux, a company having the exclusive right to operate street cars and omnibuses in this city, whose charter had still several years to run, has recently sold out to a new company, which will operate under a new charter. It is understood that the old company is to receive 12,000,000 francs (\$2,316,000) for its property and rights for the unexpired term of its charter, stockholders being allowed the option of stock in the new company on favorable terms instead of cash. The former company was English with headquarters in London; the new one is French. The chairman of the board of directors is M. Mercet, 10 Rue de Londres, Paris. It is understood that the present managing director, M. Bretherton, will continue to hold the same position under the new management. As the legal formalities are not yet complete, the terms of the new concession cannot be given. It is understood, however, that they require an immediate increase of the service in the city and vicinity, and that the new company will at once proceed to substitute electric power for horse power, which has been used heretofore. Information can be obtained by addressing M. Bretherton, managing director, Tram and Omnibus Company, Rue Tivoli, Bordeaux, France.—Albion W. Tourgée, Consul at Bordeaux.

Proposed Protection of Danish Agriculture.—Vice and Deputy Consul Blom, of Copenhagen, on August 21, 1899, writes:

The Royal Danish Ministry of Finance has just appointed a commission to consider and report on the question whether or not protection, by duties on foreign agricultural products, would be of advantage to Danish agriculture, and how such protection could be carried out.

Money-Order Department in Dawson City.—Consul McCook writes from Dawson City, July 28, 1899:

A money-order department has been opened here, which is a great convenience to parties sending out small amounts, as the cost is but five cents for a \$50 order. The first installment of second-class mail matter arrived July 5; the down-river mail comes in about twice a week.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

- No. 566. October 30.—Invention for Preventing Railway Collisions.—New French Steamer—Trade Notes from South Africa—Silkworms in China—Demand for Boilers, Engines, etc., in Guadeloupe—Demand for Iron Theaters in Spain—Ankylostomiasis in Coal Mines.
- No. 567. October 31.—Steel Roadway in Spain—Gold Production of Transvaal, August, 1899—Tin in Straits Settlements: Opening for Capital—Tariff on Corn in Venezuela.
- No. 568. November 1.—Proposed Bridge Across the Rance, France—Belgian Regulations for Manufacture and Sale of Cheese—Tariff Regulations of Kyau-chau—Electric Tramways in Northern Spain—Recent Imports into Hawaii—American Corn in Russia—Quay at St. Malo.
- No. 569. November 2.—Photographic Paper in Germany—Railway Congress at Paris—Development of New Caledonia—Quarantine in Brazil—Rice Crop of Japan—Strikes in Germany—German Emigration.
- No. 570. November 3.—Conditions in Dawson City—Gold Mining in Alaska—Artificial Coal in Germany—American Petroleum at Ghent—Substitute for Celluloid—Nettle Fiber in Germany.
- No. 571. November 4.—Cities of Paraguay.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECEIPTS.

Manufacture of Steel Balls in Europe.—According to Le Moniteur Officiel du Commerce, the number of steel ball factories in Europe was, in 1897, Germany 25 (production 4,500,000 gross of balls), France 14 (production 900,000 gross), England 7 (production 500,000 gross). One of the principal German factories at Schweinfurt-on-Main employs 600 hands and has produced in 1897 2,000,000 gross of balls. Nine-tenths of the balls made are used in the bicycle industry.

Improved Chocolate.—Prepare 1,000 grammes of finished cacao-mass and 30 grammes of fresh cacao-oil in a warmed, polished, iron mortar into a liquid substance, add to it 800 grammes of finely powdered sugar, and after a good consistency has been reached, 60 grammes of powdered ferrous lactate and 60 grammes of sugar-syrup, finely rubbed together. Further working though is still necessary, and finally scent with 40 grammes of vanilla sugar. Of this mass weigh out tablets of 125 grammes into the moulds.—Neueste Erfindungen und Erfahrungen.

Production of a Palatable and Soluble Extract of Meat Containing Albumen.—In the ordinary production of meat extract, the albumen is more or less lost, partly through precipitation by the acids or the acid salts of the meat extract, partly through salting-out by the salts of the extract, and partly by coagulation at a higher temperature. A subsequent addition of albumen is impracticable because the albumen is likewise precipitated, insolubly, by the acids and salts contained in the extract. This precipitation can be prevented according to a French patent by neutralizing the extract, before mixing with albumen, by the aid of sodium bicarbonate. The drying of the mixture is accomplished in a carbonic acid atmosphere. The preparation dissolves in cold or hot water into a white, milky liquid and exhibits the smell and taste of meat extract, if the albumen added was tasteless. The taste which the extract loses by the neutralization returns in its original strength after the mixture with albumen. In this manner a meat preparation is obtained which contains larger quantities of albumen and is more nutritious and palatable than other preparations.—Chemiker Zeitung.

Artificial Leather.—Pure Italian hemp is cut up very fine; 1 part of this and $\frac{1}{2}$ part of coarse, cleaned wool are carded together and formed into wadding. This wadding is packed in linen and felted by treatment with hot acid vapors. The resulting felt is washed out, dried and impregnated with a substance whose composition varies according to the leather to be produced. Thus, good sole leather, for instance, is produced, according to a Danish patent, in the following manner: Mix together 50 parts of boiled linseed oil, 20 parts of colophony, 25 parts of French turpentine, 10 parts of glycerine, and 10 parts of vegetable wax, and heat over a water bath with some ammonia water. When the mass has become homogeneous, add 25 parts of glue, soaked in water, as well as a caseine solution, which latter is produced by dissolving 50 parts by weight of moist, freshly precipitated caseine in a saturated solution of 16 parts of borax and adding 10 parts of potassium bichromate, the last two also by weight. Finally, mineral dyestuffs as well as antiseptic substances may be added to the mass. The whole mixture is now boiled until it becomes sticky and the felt is impregnated with it by immersion. The impregnated felt is dried for twenty-four hours at an ordinary temperature; next laid into a solution of aluminium acetate and finally dried completely, dyed, and pressed between hot rollers.—Chemiker Zeitung.

Protective Coating for Iron.—In his paper entitled "Der Eisenrost," Louis Edgar Andés gives the following concluding directions regarding the application of rust preventive coating:

1. The iron to be painted should be absolutely free from rust. It depends upon the shape of the piece whether the removal of the rust present should be carried out mechanically by rubbing with pumice stone, pieces of coke, wire brush, etc., or by the use of corrosives. If in any way possible the last named course should be avoided; but if the shape of the piece admits of no other cleansing method, great care should be taken that the subsequent alkaline bath is, and remains, sufficiently strong, and that the drying after the water bath is conducted at as high a temperature as possible and be perfect.

2. None but absolutely dry iron should be painted, and this principle should be adhered to in the subsequent coatings as well.

3. For the initial coating on iron hot linseed oil varnish should be employed, and the application be made very carefully, so that all the places are covered with it. This coat of varnish, which constitutes a sufficient protection against rust, is succeeded before the joining (places which cover each other should be painted well before joining, also bore-holes, rivet-heads, and rivet-pins) by a priming coat with pure red lead in good linseed oil varnish.

4. Only ground oil paint should be used, with suitable brushes. Mixing the pigment with the linseed oil varnish, on the spot, without grinding is inadmissible, and the painting should be performed by skilled painters and not by inexperienced workmen.

5. After the priming, three coats of paint should be put on in intervals of at least one week, but it is absolutely necessary to see that the preceding coat is perfectly dry before putting on the next.

6. The putting up of cracks, holes, irregularities, etc., is done (after the priming with red lead) with a putty consisting of red lead and linseed oil varnish, and no paint should be put on the putty till it has hardened.

7. The paint used must flow well from the brush and must have good covering power. It should not contain oil of turpentine, benzine or other hydrocarbons for diluents nor liquid driers, and must have dried sufficiently within twelve hours, so as to be no longer acted upon by rain.

8. The paint proper must answer the following requirements as regards ingredients: I. An indifferent (as far as possible) pigment requiring much linseed oil varnish to produce the suitable working consistency. And II. Pure linseed oil varnish of good quality without foreign admixtures.—Thüringer Gewerbe-Zeitung.

MISCELLANEOUS NOTES.

A glass maker of Anderson, Ind., while passing through his plant recently, observed a globe on an arc light break, and a piece of glass fall on the carbon. It was only a second until it was reduced to a liquid and dropped to the ground. This gave him his cue, and he directed the construction of a big vat, with sides and bottom composed of carbons, over which could be turned a lateral and longitudinal current. An arrangement being made to run the sand through this vat, the plan worked perfectly, the best molten glass being thus turned out in about as many seconds as requires hours for the old fuels to melt it. The vat has been patented.

The Pan-American Railway from New York to Buenos Ayres will, according to a voluminous seven volume report lately issued by the Intercontinental Railway Commission appointed as a result of the Pan-American Congress of 1890, when completed, have a length of 10,228 miles. Of this, 4,772 miles are already built, leaving 5,456 to be constructed. The 2,094 miles from New York to the Mexican border are in active operation. So are the 1,183 miles thence to Oaxaca, Mexico. These make a total of 3,277 miles, or about two-thirds of the grand total of road already existing. The remaining one-third of existing railroad is distributed as follows: Guatemala has 44 miles, in round numbers; Salvador, 64; Nicaragua, 103; Peru, 152; Bolivia, 195; and Argentina, 937; Honduras, Costa Rica, Colombia, and Ecuador, not a single mile. There must be built in Guatemala, 127 miles of railway; in Salvador, 167; in Honduras, 72; in Nicaragua, 106; in Costa Rica, 360; in Colombia, 1,354; in Ecuador, 658; in Peru, 1,634; in Bolivia, 393; and in Argentina, 125 miles. According to the report of the commission, the cost of constructing these links will approximate \$175,000,000. There will still remain the outlay for permanent buildings and rolling stock, the cost of maintenance in repair, and the current operating expenses. In order to make the links of any value, there must be leases, or other working arrangements, with the roads already in existence.—Fielden's Magazine.

The efforts of some French scientists to utilize alcohol as a motive power for the propulsion of motor cars have not yet been attended with very hopeful results. These efforts were put forth ostensibly with a view of alleviating the distressed condition of agriculture, but it is to be feared that relief will have to be sought for in some more promising direction. The idea that suggested some experiments was that French alcohol, in a vaporous state, might be substituted for the light oils imported from Russia and the United States, now so largely used in car propulsion. Considerable expense has been incurred in experimenting, in order to ascertain the relative efficiencies of alcohol, and of benzene and other light oils. Trials were made with a Broichot horizontal engine of two to three horse power and a Benz vertical motor of three to four horse power, but the new fuel failed to approach anything like the economy realized by the light oils. In the first place, an analysis showed that the alcohol had only about one-half the carbon of a mineral oil, with forty-five times the oxygen, and its calorific value was little more than one-half. In the horizontal engine the consumption was something over 2 pounds per horse power for light oil, as compared with 3.85 pounds for alcohol with the engine at half charge; but at full charge the difference was hardly so great. The consumption of light oil with the Benz vertical motor was only 0.89 pound per horse power for a full charge, and of alcohol over $\frac{1}{2}$ pounds, so that the result is almost double the consumption. Then alcohol is double the price of even the fine light oils in France. So that the power obtained from one shilling's worth of ordinary petroleum, or with one and ninepence worth of light oil, cannot be realized from alcohol at a less expense than five and sevenpence.

Bridges of various characters, movable in different ways and used over navigable channels, have been described in these columns from time to time, together with the means used in their operation. One of the oddest which has come to notice is one on the Nicolas Railway in Russia, which is believed to be unlike anything existing in this country. The stream spanned has a width of only about 33 feet, and in this country the bridge erected would probably have been a single bascule with rolling counterweights like some recently erected on the Erie Railroad, or of the rolling-lift type like those installed just outside the new Southern Terminal in Boston. The bridge under description is for two tracks, and the span for each track is composed of two independent parts, one consisting of a carriage-like a transfer-table in general plan and the other is a rolling or retractable bridge. This plan has the disadvantage of necessitating an abutment nearly twice the extent of the width of the stream and wide enough for four tracks. Beginning the description at the shore-end of the side from which the bridge is operated, the tracks are first laid upon a movable section of a length equal to the channel-span. This section, which is independent for each track, is carried on wheels moving on rails laid transverse to the axis of the bridge. Connecting with these sections are two other sections, one for each track, carried on plate-girders a trifle less than twice the length of the channel-span, and these sections are carried on trucks moving on rails laid in the direction of the length of the bridge. The shore-end of the rolling-part of these sections is shorter than that which covers the stream, and it is accordingly counterbalanced by the addition of weights. In its closed state the bridge and the carriages rest upon fixed supports and may be considered as rigid structures. When opened to allow of the passage of boats, the first movement is made by forcing the points carrying most of the weight by raising them to a certain height by means of a special mechanism consisting of a combination of an eccentric gear and an endless screw. The two shore-sections are then moved aside right and left until they occupy positions parallel with their original ones and distant therefrom the width of one track, or sufficient to allow the channel-part of the bridge to be retracted. The rolling part projecting over the channel is then moved back upon its own axis, occupying the space vacated by the shore-section which had been moved laterally aside. The bridge is protected by special electrically-operated signals.—Providence Journal.

SELECTED FORMULÆ.

To Bleach Sponges.—A method commonly employed for bleaching sponges is as follows. First, prepare two solutions according to the appended formulæ:

1. Potassium permanganate..... 25 grains.
Pure water..... 1 pint.
2. Sodium hyposulphite..... 2 ounces.
Hydrochloric acid..... 1 "
Water..... 1 pint.

Dissolve the hyposulphite in the water, add the acid, let stand 24 hours and decant from the sediment. The solution should be made in the open air, care being taken not to inhale the fumes that arise. Free the sponges from sand and other extraneous matter first by beating and then washing thoroughly with water. Squeeze them as dry as possible and then immerse them in the solution of permanganate, allowing them to remain in the liquid a few moments, or until they acquire a dark-brown color. After removal from this solution, dip the sponges, a few at a time, into the hyposulphite preparation, allow them to become thoroughly saturated, and then remove and wash in water until the odor of the solution is entirely removed. Squeeze out, and when nearly dry, immerse in a solution of $\frac{1}{2}$ ounce of glycerin to 1 pint of water, and finally dry in the shade. Care should be taken not to expose the sponges to the action of either bath longer than is actually necessary to effect the desired object. While the substance of the sponge is said to be but slightly affected, if at all, by this treatment, prolonged exposure will be injurious.

Floor Waxes.—1. One kilogramme of yellow wax and 1 liter of water are heated to boiling; 63 grammes of potash are added, dissolved in a little water; the mixture is boiled for a few minutes, removed from the fire, and 50 grammes of oil of turpentine, 1 liter of boiling water and 15 grammes of annatto are added. Stir continually until cold, and apply on a rag.

2. Dissolve 100 grammes of yellow wax on a water bath in 200 of oil of turpentine.

3. Boil 40 parts of yellow wax with 160 of water and 5 of potash. Add 4 parts of oil of turpentine and water enough to make 200, and stir until cold.

4. Dissolve 32 parts of potash in 314 parts of water; heat to the boiling point and add 32 parts of yellow wax and 8 of annatto.—Druggists' Circular.

Harness Polish.—

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|---------------------------|-----------|
| Mutton suet..... | 2 ounces. |
| Beeswax..... | 6 " |
| Candied sugar..... | 6 " |
| Soft soap..... | 2 " |
| Lampblack..... | 1 " |
| Spirit of turpentine..... | 4 " |
| Water..... | 4 " |

Harness Blacking.—

- | | |
|-----------------------------------|-----------------|
| Soft soap..... | 3 ounces. |
| Isinglass..... | 3 " |
| Prussian blue..... | $\frac{1}{4}$ " |
| Transparent glue..... | 2 " |
| Logwood..... | 2 " |
| Vinegar..... | 24 " |
| Lampblack, a sufficient quantity. | |

Simmer the ingredients together over a slow fire and strain.

Piano Polish.—

- | | |
|-----------------------------|-----------|
| 1. Gum mastic..... | 65 parts. |
| Shellac..... | 250 " |
| Alcohol (95 per cent.)..... | 1,000 " |

For the finest work, the alcoholic solution of the gums should be shaken with about one-tenth of its volume of benzine, and the latter drawn off after the mixture has been allowed to stand for a few hours. This gives greater mobility.

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|------------------------|-------------|
| 2. Egg whites..... | 11½ ounces. |
| Raw linseed oil..... | 8 " |
| Wood alcohol..... | 2½ " |
| Oreil..... | ½ " |
| Hydrochloric acid..... | 2 " |
| Vinegar..... | 8 " |

—Druggists' Circular.

Hair and Scalp Wash.—

- | | |
|------------------------------|----------------------|
| 1. Ammonia water..... | $\frac{1}{2}$ ounce. |
| Tincture of cantharides..... | $\frac{1}{8}$ " |
| Cologne water..... | 1 " |
| Water, enough to make..... | 8 " |

Apply to the scalp with a sponge morning and evening.

- | | |
|---------------------------------|----------------------|
| 2. Tincture of capsicum..... | $\frac{1}{2}$ ounce. |
| Tincture of soap-tree bark..... | 1 " |
| Glycerin..... | 2 drachms. |
| Tincture of cantharides..... | 3 " |
| Spirit of rosemary..... | 1½ ounces. |
| Rose water, enough to make..... | 8 " |

FRENCH HAIR TONIC (ESPRIT DE CHEVEUX).

- | | |
|-------------------------------|-----------------|
| 3. Oleo-balsamic mixture..... | 4 fl. ounces. |
| Glycerin..... | 5 " |
| Rose water..... | 20 " |
| Tincture of cantharides..... | $\frac{1}{2}$ " |
| Ammonium carbonate..... | 1 ounce. |

Mix, shake thoroughly, let the mixture stand for one hour, and filter.

How to Unite Rubber and Leather.—In answer to a correspondent the Gummi Zeitung gives the following advice. Roughen both surfaces, the leather and the rubber, with a sharp glass edge; apply on both a diluted solution of gutta percha in carbon bisulphide, and let this solution soak into the material. Then press upon each surface a skin of gutta percha, 0.25 millimeter in thickness between rolls. The two surfaces are now united in a press, which should be warm but not hot. This method should answer in all cases where it is applicable. The other prescription covers cases in which a press cannot be used. Cut 30 parts of rubber into small pieces, and dissolve it in 140 parts of carbon bisulphide, the vessel being placed on a water bath of 30° Cent. (86° F.). Further, melt 10 parts of rubber with 15 of colophony, and add 35 parts of oil of turpentine. When the rubber has been completely dissolved, the two liquids may be mixed. The resulting cement must be kept well corked.

(Continued from SUPPLEMENT, No. 1245, page 19960.)
STREAM MEASURING IN THE UNITED STATES.*

By F. H. NEWELL.

WHEN the velocity of the water is considerable, as, for example, over 5 or 6 feet per second, the sounding line and meter are apt to be swept backward down the stream. In such cases it is often necessary to provide an additional stay line. This consists of a second cable or smooth wire stretched across the stream at a distance of from 50 to 100 feet above the bridge or cable from which measurements are made. A small twisted wire clothesline or sash cord may be used for this purpose. It is anchored at both ends and supported in a manner similar to that of the main cable. On this smooth wire is a small pulley, which travels freely from side to side of the river, and from the pulley there is a small flexible cord leading diagonally down stream. This may be attached to the end of the sounding rod, holding it in position, or a fine wire may be similarly fastened near the head of the meter, so that when the instrument is lowered it is held from being carried backward or tilted by the force of the current. The stay line usually adjusts itself as the hydrographer moves from one side of the stream to the other.

Some of the meters in use have self-registering devices, the dials being read before and after the instrument is immersed. The kind, however, most generally used for this Survey is provided with a simple make-

inches thick, and 2 inches high. It is charged each time by inserting from $2\frac{1}{2}$ to 3 grammes (or 33 to 46 grains) of mercuric bisulphate, the cell then being filled with water. After using, it may be washed out. This cell is placed in a small sole-leather case, having on the outside a very small electromagnet with armature set upon a spring, this device being protected by a metal cover about $1\frac{1}{2}$ inches in diameter. The whole instrument weighs only a few ounces, and when attached to the end of the double-conducting electric cord does not add appreciably to the weight. The instrument being so small and stout, it is possible for the hydrographer, when working from bridges, to toss the end of the wire around beams or braces, and thus to swing his meter along around piers and projections without the necessity of disconnecting the wires.

On Pl. IV. are shown two of the electric meters in common use by this Survey in its river measurements. The upper one is the ordinary Price electric meter, made by W. & L. E. Gurley, Troy, N. Y., and the lower a smaller modification of the same instrument, made especially to fill the needs of this Survey. With each of these instruments is shown a coil of common cotton-covered double incandescent electric light wire, which serves to support the instrument and to conduct the electric current. In each case the cord terminates at the battery and buzzer in the upper portion of the picture, this being shown complete and closed for use. On the lower half of the plate the leather battery box is shown open, with

tion, and this in turn is multiplied by the average velocity as ascertained by use of the current meter. The total of the fractional discharges thus obtained is taken as the total discharge, and this latter divided by the total of the fractional areas gives the mean velocity in feet per second. In computing the discharge for the end or shore portions of the cross section of a stream, special attention must be paid to sluggish or back water and due allowance made for the shape of the banks.

The result of any one discharge measurement gives simply the quantity of water passing at time and place. In order to estimate the amount passing day by day, it is necessary either to make daily measurements or to compute what these should be by assumptions based on the height of the water. In the case of the ordinary unnavigable stream, where the banks and bed are not being rapidly eroded and sediment is not being deposited, it is safe to assume that for a given height of water the discharge is fairly constant, although, as a matter of fact, when the river is rising there may be more water passing down stream at a given arbitrary height than when falling. This difference, however, is usually negligible. If, therefore, the quantity of flowing water can be ascertained for each small interval of rise of the stream, it is practicable to construct a table showing for any given height the amount flowing. This is what is actually done in the

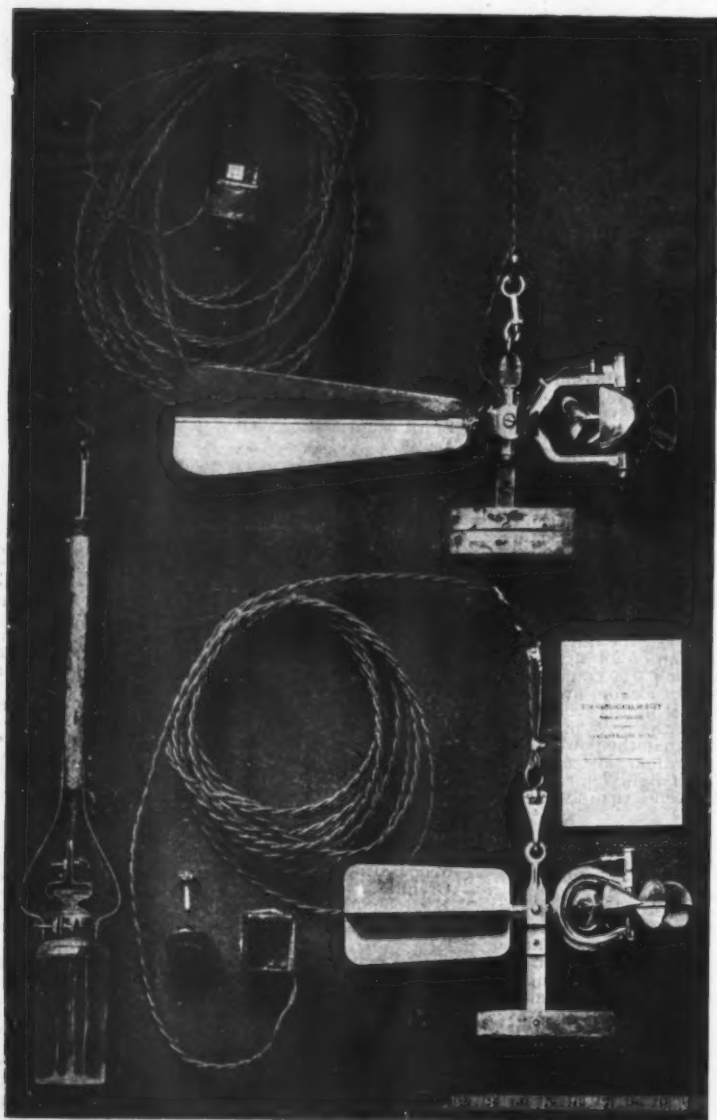


PLATE IV.—PRICE ELECTRIC CURRENT METERS, WITH BUZZERS.

and-break circuit device, this being connected by suitable wires to a telegraphic sounder or some form of recording apparatus. Nearly all engineers taking up work of this kind at first prefer the somewhat elaborate and cumbersome instruments which record the readings upon dials, some of these giving the time in seconds as well as the number of revolutions of the meter wheel. The more experienced men, however, prefer to reduce their equipment to the simplest possible form, and, instead of reading dials, count the clicks or noise made by the miniature sounder, keeping the time by watching the second hand of an ordinary watch while it marks off fifty seconds. Many forms of stop watch have been tried, but these are so liable to injury or to get out of order and repairs are so costly, that, as a rule, their use is soon abandoned in favor of the watch ordinarily carried. The form of sounder usually preferred is made up of a small hard rubber battery cell with zinc pole passing through the rubber stopper. This cell is about $1\frac{3}{4}$ inches wide, $1\frac{1}{4}$

the cell removed, and slightly to the left and above this the zinc pole.

On the lower left hand side is shown a device for taking water samples, consisting of a clutch holding a wide-mouthed glass bottle. This is so arranged that the device can be screwed to the end of ordinary gas pipe and lowered into the stream to the desired depth. The stopper of the bottle is then drawn by pulling a cord which runs through the pipe; the bottle being filled immediately, the stopper is forced back into position by the spring shown above the stopper. On being withdrawn from the water, the bottle, with the stopper in it, may be quickly removed from the clutch by loosening the set screws, and another empty bottle, sterilized if necessary, may be immediately inserted. Other meters in use are illustrated by Figs. 3 and 4.

The results of stream measurements are stated in cubic feet per second, or second-feet, as the term is abbreviated; therefore the linear measurements are made in feet, and the results of the use of the current meter, primarily in revolutions per second, are converted by the rating table prepared for each instrument into velocity in feet per second. If the tags at the river station are 10 feet apart, the average depth as obtained by sounding is multiplied by 10 feet, giving the area in square feet of this portion of the sec-



PLATE V.—MEASURING VELOCITY OF WATER FROM SUSPENDED PLATFORM, ON RUM RIVER ABOVE MILL POND AT ANOKA, MINNESOTA, AUGUST, 1897.

case of each regular station, and, in addition, the height of water day by day or morning and evening is recorded, the estimated quantity in the river being taken from the table and set opposite the corresponding figures for height.

At some favorable point near or a short distance above or below the place where the measurements are made, a gage is erected and readings are taken at regular intervals. Where an observer can be found whose occupation or duties are such that he can readily examine the gage, it is customary to have these readings made twice a day: if there are no houses in the vicinity and a trip of a mile or more must be made for each reading, this may be made once a day, or even in some cases only every other day, except during times of flood or rapid change. The readings on the gage are noted in a small book and are copied upon the postal cards sent to the field men or the local office at the end of each week.

The gage may consist of a simple vertical scale divided conspicuously into feet and tenths and nailed to a pier or post in the water; or it may be an inclined stick of timber following the general slope of the bank and marked by means of a level to equivalent vertical feet and tenths. This latter form, while more expensive and difficult to install firmly, has the advantage

* Being the Introduction of the Report of Progress of Stream Measurements for the Calendar Year of 1897, including papers by Dwight Porter, J. B. Lippincott, and other hydrographers. Forming part of the Nineteenth Annual Report of the United States Geological Survey to the Secretary of the Interior, 1897-98. Reprinted from Part IV. Hydrography. F. H. Newell, Chief of the division. Reprinted by permission of the Director of the United States Geological Survey, Hon. Charles D. Walcott.

that the readings are always at the edge of the water and are easily made. When measurements are made from a bridge, in place of the vertical scale, or in addition to it if it can not be easily seen, there is sometimes put in position a long flexible wire with a weight at the lower end. For the wire, galvanized sash cord is employed. This passes over a pulley and is allowed to run out until the weight just touches the surface of the water. The cord above the pulley extends horizontally, and the handle at the end is so arranged that it can be placed against a horizontal scale located so as to give the same reading as the gage on the pier. As soon as the weight touches the water, the reading is made. The wire is then pulled back horizontally, hoisting the weight up against the bottom of the

its values are applied to the record of height, giving a statement of the daily discharge. These figures of daily flow are not published in the following report, but in their place are given the maximum and minimum for each month and the average, this being stated in cubic feet per second. The total for the month is also given in acre-feet, that is, in quantities equivalent to the given number of acres 1 foot in depth, 1 acre-foot being equivalent to 43,560 cubic feet. This total monthly flow is also expressed in terms of the area drained, that is, in depth in inches, assuming that the water came from all parts of the catchment basin, and in cubic feet per second per square mile of tributary territory. The daily fluctuations are also shown in diagrams, since these give at a

the door of the house in which the car and smaller tools are stored.

In the view, *B*, is shown the apparatus used at Los Angeles, Cal. This consists of a cement-lined trough along the edge of the reservoir. Above this is stretched an iron cable, suitably supported, and on the latter is a trolley with two wheels, by means of which the meter is supported beneath the surface of the water.

By means of such a device the meter is propelled through the water over a measured course, usually of 100 feet, for 30 or more times in succession, the speed varying from less than one-half foot per second up to 6 or 8 feet per second, or even more, the number of revolutions per hundred feet and the number of seconds being noted. There is thus obtained the feet per



FIG. 3.—HASKELL ELECTRIC CURRENT METER, LARGE FORM.

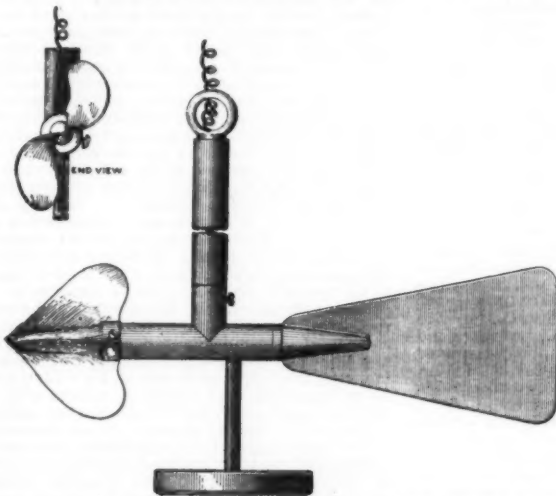


FIG. 4.—HASKELL ELECTRIC CURRENT METER, SMALL FORM. (One-fourth natural size.)

bridge, the handle being usually locked to some brace so that the device can not be disturbed, the wire being usually out of sight or difficult of access.

As all gages are liable to change, injury, or even destruction, during times of high flood, it is essential that some permanent mark or marks be placed on the ground and connected by careful lines of level, so that the gage may be tested or restored. In the case of inclined gages, frost is liable to alter the relation of the readings, and the wire gages may stretch. The bench marks used may be any solid objects easily found, as, for example, a mark on the stone foundation of a building or bridge pier, a spot moved off on a rock, or even a notch cut in a solid stump or log. From season to season it is desirable by means of a Wye level to verify the measurements previously made.

The relation between the quantity of water flowing in a stream and its height from some arbitrary gage being once established, it has been found that this remains fairly constant through a number of seasons. Measurements are made, however, at short intervals to verify this fact or to modify the rating table in case of slow progressive changes. After an unusual flood it is not uncommon for the conditions to be so greatly changed that a new rating table is necessary. During the period for which the rating table is constructed,

glance and in the most concise manner the character of the stream.

RATING THE METERS.

The relation between the revolutions of each meter and the speed of the water is a matter which, as before stated, must be determined for each instrument and tested at short intervals while in use. In order to run the meter at uniform velocities through still water, it is necessary that the instrument be supported on some sliding object. Several devices have been adopted, two of which are illustrated in the accompanying plate (Pl. VI.) In the view marked *A* is shown the apparatus for rating meters at Chevy Chase, Md. This consists of the platform, about 200 feet in length, built along the edge of a small deep pond whose waters are practically stagnant. On the outer edge of this platform are small iron rails, on which is placed an ordinary mine car or truck, with outrigger such that the meter can be held vertically over the water and immersed to the desired depth. On the platform a measured course of 100 feet is laid off, and the car is pushed by hand, care being taken to pass over every 10 or 20 feet in a uniform number of seconds, so that the same velocity may be maintained from start to finish. In the view a meter is shown suspended from the car on the right hand side, and another meter in the background against

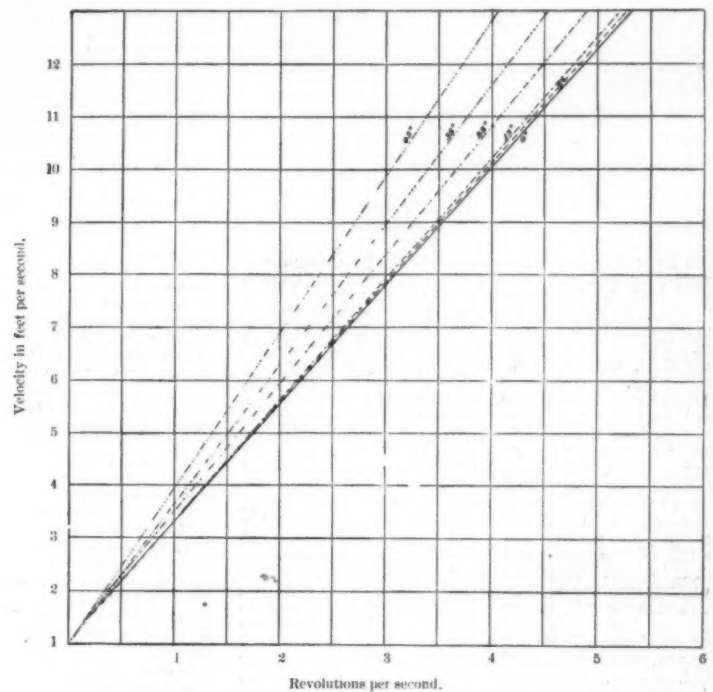


FIG. 5.—RESULTS OF RATING METERS WHEN INCLINED AT VARIOUS ANGLES.

second and the revolutions per second at different speeds. When these data are plotted upon cross section paper, it is found that for higher velocities the points lie in nearly a straight line, but for lower velocities there is a tendency for the revolutions per second to decrease, owing to the slight friction in the instrument. A broken or somewhat curved line is therefore sketched for the lower velocities, and from this curve values are taken to make the arbitrary table of the relation between revolutions of the meter per second and speed of the water. This table is found to be fairly constant until the meter becomes injured or the friction notably increases by the wearing away of the more delicate points of the bearings.

INCLINATION OF THE METER.

In using current meters, especially those suspended from a cord or line, it is frequently the case that in swift water the instruments are swept backward and tipped at an angle from the horizontal, either momentarily or for a considerable interval of time. In order to obtain data concerning the reliability of results under such conditions, a series of tests were made at the rating station at Chevy Chase, Md. A small Price current meter was used, held rigidly at various angles as measured from a horizontal line. The results are shown graphically on the diagram, Fig. 5.

In the first case, at zero, the meter was held firmly



PLATE VI.—APPARATUS FOR RATING METERS.

A, at Chevy Chase, Maryland; *B*, at Los Angeles, California.

parallel to the surface of the water and caused to move through the water at uniform rate, the speed per second and revolutions per second being ascertained as in the ordinary operation of rating the instrument. Various velocities were used and figures obtained from which a rating table was constructed graphically. The meter was then inclined at an angle of 5 degrees and the operations repeated, obtaining a complete rating table for the meter when inclined for this angle. The same series of observations were made at inclinations of 15 degrees, 25 degrees, 35 degrees, and 45 degrees. The various lines showing the relation between velocity per second and revolutions per second are shown on the accompanying figure (Fig. 5), each being marked with the corresponding angle. On examination of this it appears that the divergence of the rating is relatively slight, even when the meter is inclined at angles of from 10 to 15 degrees, but increases with considerable rapidity for higher angles of inclination. At a velocity, say, of 4 feet per second the revolutions per second at zero and at 5 degrees are the same, 1.76; at 15 degrees are slightly less, 1.74; at 25 degrees are notably less, 1.63; decreasing still more for 35 degrees and 45 degrees.

ORDINARY FLOW OF A STREAM.

The question is frequently asked: What is the ordinary or usual flow of a given stream? This question, at first sight simple, is, upon further consideration, found to be susceptible of a variety of answers. By examining any of the numerous diagrams of daily discharge published in this and preceding volumes, it will be seen that the fluctuations from day to day and from year to year are so great that the stream can scarcely be said to flow with regularity for any considerable period. An exception to this may occur during the summer droughts, when the river gradually shrinks or maintains its flow through deep-fed springs or seepage. For this season there may be said to be an ordinary flow, but this amount is not applicable to the whole year.

In the computations of discharge the average flow has been estimated by months and from this by years; but this average does not fulfill the conception of ordinary or usual flow, since it is notably increased by floods. An arbitrary definition has been suggested in Rankine's Civil Engineering.* According to the rule there given, the discharges, as observed daily, are arranged in the order of their magnitude, without regard to dates. For a full year there would thus be 365 figures, arranged in order from the smallest to the largest. The list thus arranged is divided into an upper quarter, a middle half, and a lower quarter; or, in other words, the first 91 figures are taken out to represent low water conditions and the last 91 to represent flood conditions. The average of the middle half is taken, and is used in place of each of the 91 high, or flood, values. The mean of the whole list is thus taken as the ordinary or average discharge, exclusive of flood waters. It is claimed that the ordinary discharge, as computed in this manner for a number of streams in hilly districts, has ranged from one-third to one-fourth of the mean discharge, including floods.

REPORT OF THE CHIEF OF THE BUREAU OF STEAM ENGINEERING.*

GENERAL OPERATIONS OF THE BUREAU.

WHILE the legislation of the last Congress provided for an increase of the navy by appropriating for three sea-going coast-line battleships, three armored cruisers, and six protected cruisers, the limitations placed upon the price of the armor and the clause which prevented contracts being made for the hull until the armor for the first two classes of the above vessels had been contracted for presented insuperable obstacles in the way of proceeding promptly with the building of the same, the price of armor mentioned in the bill being far below that for which any manufacturer would deliver it.

On this account the immediately necessary designing work in this bureau upon new ships was confined to plans for the machinery of the six protected cruisers, as will be noted under the head of work in the drawing room.

Plans of general arrangement of machinery for the armored cruisers, however, have been pursued to such a degree as is warranted by the available outlines, so that when the matter of cost of armor is adjusted and further progress of plans justified, the completion of the designs will be a matter requiring but little time.

The usual extensive and laborious duty connected with the working out of details for machinery already under construction, and the examination and correction of designs submitted by contractors, have been continued in a manner highly satisfactory in results. The matter of designing the internal arrangements of machine shops at New York, Port Royal, Key West, and Mare Island has also demanded considerable attention, in order to provide for the most efficient disposition of tools when installed.

In my last annual report I alluded to the extraordinary conditions which were then prevailing, and included the general items of importance in the machinery repair work of this bureau up to the date of writing that report, October 1, 1898, at which time the cessation of hostilities had about taken effect. Necessarily the results of the extraordinary duties of the various ships under such circumstances were not fully realized by the bureau until the return of the fleets to the repair stations, but it was a matter of gratifying surprise to the bureau to find the extent of needed repairs as limited as it was, being generally confined to portions of the machinery such as boiler tubes and condenser tubes, which are most readily affected by the extreme conditions prevailing in war times. The generally excellent condition of the engines of our ships after these trials is a reflection of a highly complimentary character upon the bureau's control of the designs of the machinery and upon the efficiency of the officers under whose direct charge their operations were conducted.

The matter of completely repairing all the ships, both

of the regular navy and those retained from the auxiliary fleet, was taken promptly in hand as ships returned to the various yards, and the aggregate cost assumed small proportions compared with what might have been anticipated. Most of this work has now been effected, and yet, owing to the unexpected retention of very many of the auxiliary ships for use in naval service, the estimates made by the bureau in the last annual report for current expenses, 1899-1900, fell far short of the amount actually required, as at the time of the report it was the general impression that upon the close of the war most of the auxiliary ships would be sold or otherwise disposed of. A portion of the large balance remaining in the Treasury from the emergency fund under this bureau (between two and three millions) could be very properly reappropriated for this unanticipated work, by special legislation, and obviate the necessity of asking for further provision for current work in the coming deficiency bill. I desire to call your attention to the above circumstances in view of the necessity of thus further providing for the expenses of the present fiscal year.

The general lessons from the war were in no way indicative of any desirable change in the machinery of our ships, with the exception of increasing the evaporating plants, and the adoption with all practical and economical promptness of the water-tube type of boilers.

PERSONNEL.

I approach the subject of the personnel with some hesitancy, owing to my inability to see indications of the desired result from the operations thus far of the personnel bill. It was my earnest hope that upon the taking effect of that bill the whole trend of detail would be toward the complete amalgamation of line and engineering interests in the navy with the most favorable outlook for the protection of the rapidly advancing engineering science. My belief in the spirit of the bill was that it contemplated most earnestly vast additions to the number of officers who would give earnest attention to engineering matters, and in no way imply a desire to augment the forces available for merely former line or deck duty. The comprehensive union of the line and engineering vocations I still hope will be the result of the personnel change, and I earnestly request that no department regulations may be formulated or permitted to exist which will in any degree tend to destroy this belief or prevent such a construction of the intention of the bill. Briefly, the fate of the reconstruction of the personnel hinges upon the provisions made for future and continuous supply of efficient engineers in the navy. The duties of the line were believed to be perfectly compatible with a professional excellence in engineering matters by an individual. A not unwarranted expectation is that preference for the mechanical part of these combined duties will be shown by a great number, owing to the intense interest attaching itself to this field of work and to its almost universal application to the progressive arts of the age. The only plausible scheme, therefore, is to insist upon the present line officer adapting himself as soon as possible to the new conditions, and increasing, where lacking, his knowledge of mechanical engineering. Primary instruction has already been given to graduates of the Naval Academy. Necessary practice is easily attained. Departmental regulations insisting upon alternations for the present watch officers in deck and engine room duties will accomplish the latter end. Efficient and complete instruction at the Naval Academy will enable the future line officer, even more rapidly than now, to grasp the new work and control it successfully. The practical instruction of the present watch officer as above suggested is a fundamental and vitally necessary feature which, in my opinion, should govern the rulings of the department from now on.

I must earnestly invite your attention in this connection to the status of steam and mechanical engineering to-day. Various outcroppings in the shape of electrical, hydraulic, and pneumatic specialties divert the thoughtless into considering these fields fundamentally separate from that of steam engineering, while the fact remains that the man educated fully in "steam engineering" is in the very front rank of the advancing workers in such specialties. The principles of the side branches are of extreme simplicity, those governing the construction of the mechanisms being essentially the same as in good mechanical engineering.

It is only necessary to push aside the more or less plausible superficialities which would lead to a misjudgment of these facts and look for a moment upon the real requirements to realize how fundamentally important and distinct are the duties of a mechanical bureau, and also to be convinced of the wisdom of using every exertion to provide the highest special talent for its future operation. I regret the matter of combination of bureaus has been even speculated upon. This regret, I assure you, in no way comes from motives other than the belief in the impossibility of a successful issue of such a scheme. Not only is the trend of modern mechanical work in all branches toward increased specialization, but the wisdom of such a trend is never questioned by the leading talent in the outside world of constructive work.

ELECTRICALLY DRIVEN AUXILIARIES.

For some time past—in fact, ever since the successful use of electric motors for general power purposes on shore—the bureau has been carefully investigating their adaptability to the driving of the numerous auxiliary engines on board ship, and, in view of the conclusion that the electric drive of the auxiliaries would not, under existing conditions, be so satisfactory and economical, on the whole, as the steam drive, believes it would be of interest to state the reasons for this conclusion.

This is the more appropriate because in some quarters the fact that electric motors are extensively used on shore has led to the belief that they would be equally successful on board ship. The bureau has planned to use electric motors exclusively in its new plant at the Brooklyn navy yard, and it will be readily appreciated, therefore, that their non-use on board ship is for very good reasons.

The advantages claimed for electric motors over small steam engines on board ship may be classed as greater ease of operation, avoidance of heat, which accompanies the use of steam pipes in living places,

and much greater economy. Against these, however, are to be put the much greater weight of the necessary electric outfit, the greater delicacy of the type of electric motors ordinarily used, the lack of ready adaptability to the various conditions of service, a general denial of the claims for economy as ordinarily presented, and the increase in the amount of space required below the protective deck for the installation of the necessary dynamo rooms, this space being necessarily taken from coal bunkers.

On board ship, where excess of weight is so carefully guarded against, it would certainly be very unwise to adopt a change of motive power involving great increase in weight, unless the advantages gained are very material. It must always be remembered that, speaking generally, on board ship the use of an electric motor involves a total weight for the motive power at least three times that of the motor itself, because there is always the generator and its driving engines, besides the motors supplied by them; or, in other words, the electric drive of an auxiliary will weigh at least three times as much as the steam drive, assuming the motor to weigh no more than the engine it displaces, although usually it does weigh more. The answer which would be made to this is, of course, very familiar to anybody who has studied the problem, viz., that the auxiliaries are not all in use at one time, and that therefore the generator capacity required is considerably less than the total motor capacity. This is another case where a statement which may be true elsewhere is not true for the circumstances on board ship. Our naval machinery has to be designed so that in time of action everything can be ready for use, and, as a matter of fact, a very little study of the question will show that it not only may but almost certainly would happen that every auxiliary on the ship, except the capstan engine and some of the boat winches, would be used simultaneously. Therefore this statement with regard to the generator capacity does not hold on board ship.

Another statement to which very emphatic objection must be entered is in respect to the enormous gain in economy claimed for the electric drive of the auxiliaries, which is obtained by taking the highest figure for the efficiency of the generator and motor and also the most economical steam engine, and by comparing these results with the uneconomical form of steam cylinders which, for very good reasons, have until recently ordinarily been used with the steam-driven auxiliaries. If the electric generator was of relatively large size and the motors worked always at their most economical speed and load, there might be some justification for this claim; but, as a matter of fact, the very circumstances under which the auxiliaries on board ship are worked require a very wide range of speed and power, and I believe that electric experts admit that electric motors as at present designed when run under these conditions are by no means economical, so that, without considering the economy of the engine driving the electric generator, the economy of motor-driven auxiliaries at speeds differing materially from the most economical would be widely different from those which are set forth by the advocates of their universal use on board ship. The natural result of the foregoing is that with the widely varying speeds of the auxiliary machinery, there is required at the generator the development of an almost constant power which is very near the maximum, and which depends only upon the number of auxiliaries in use.

I wish to emphasize the point that the objection to using electric motors for driving the auxiliaries on board ship is not an objection to the use of electric motors per se, but to installing them in a location for which they are not adapted, and where their good features cannot be utilized. What has led to the wide use of electric motors on shore is not only the absence of heat, cleanliness, and ease of installation and operation, but above all the simplicity of the transmission of power from a central station to a distance. Now the great majority of the auxiliaries on board ship are so near the boilers that less piping is involved in a direct steam drive than in an electric drive from dynamos necessarily at some distance from the boilers.

The ease of transmitting power to a distance over a wire, as compared with great lengths of steam piping, gives the electric drive a very attractive side, even for distances no greater than the maximum ones on board ship, so that we should naturally expect to find electrically driven capstans and steering engines. These two auxiliaries are not under this bureau, but are the ones requiring long and objectionable steam pipes through the living spaces. Here, however, another point has been made by some who are very anxious to use motors elsewhere, viz., that for the service in these cases motors are not sufficiently reliable. Naturally a system involving four parts, each liable to break down, is more delicate than one involving but two of these parts. With a steam drive there are the boilers and the steam engine driving the auxiliaries. In the electric drive we have the boilers, the steam engines, and also the electric generators and motors. It is merely a detail whether the steam engines operate the auxiliaries directly or whether a smaller number of them, having a greater power in each engine, operate electric dynamos. Personally I should think, however, that if motors are considered sufficiently reliable to drive feed pumps and air pumps on shipboard, for which they are not well adapted, they would be reliable for these other two cases noted, which they fit so well otherwise. The absurdity of an electric drive of auxiliary machinery on board ship situated closer to the main engines than the engines driving the dynamos becomes all the more apparent when contrasted with the steam drive for auxiliaries situated in the very extreme ends of the ship.

The fact is that within what are ordinarily called the "machinery compartments of the ship" the leading of the necessary steam and exhaust pipes for auxiliaries does not interfere with anybody's comfort nor does it raise the temperature unduly, and the distances are so short as to make the lead of piping very easy. Steam auxiliaries answer admirably the demands which come upon them at all speeds within their capacity, and the only possible objection which can be urged against them is that the simple forms usually employed for reliability are not so economical as the more elaborate ones which can be used elsewhere. They are far superior to electric motors on the score of adaptation to the service to be performed, and also far better for naval

* Manual of Civil Engineering, by William John Macquorn Rankine. London, 1885, page 698.

† Extract from Annual Report of Rear-Admiral Melville.

use on the score of weight. On the score of economy we have shown above that the claims ordinarily made for the electric drive are not tenable, except under special conditions, and it is further to be said for the steam driven auxiliaries that at the times when economy is of the greatest importance when making long sea trips only a small part of the total auxiliary capacity is used, so that even if the saving by the use of electricity was what is claimed by the most enthusiastic electrical agents, the aggregate amount of fuel saved would be comparatively insignificant and considerably less than the reduction in bunker capacity necessarily incident in a ship of a given size to the use of the electric drive.

It must also be noted that all the published statements of the superior economy of electrically operated auxiliaries are based on steam auxiliaries where every steam cylinder was of the least economical kind, and where, for good reasons, well-known measures of economy had not been installed. An inspection of the bureau's recent designs will show that by the use of compound engines as motors, feed heaters for the exhaust, the use of the exhaust steam from the auxiliaries in the receivers of the main engines, and other economical devices, the expenditure of steam in the auxiliaries is brought much below that of the old simple engines, and indeed below that of the electric drive except under very favorable conditions, while avoiding the increased complication and weight which necessarily accompany electrically driven auxiliaries on board ship. I may be permitted to call attention in this connection to the fact that those designers abroad who have the most extended experience are working on this problem of the economy of auxiliaries along the same lines that the bureau has been following. Although the statement is very often made that the electric drive of the auxiliaries is being rapidly adopted in all foreign navies, this is far from accurate. It is being tried on some ships in some navies, but is as yet entirely in the experimental stage. These experiments have been carried quite as far in our navy as in any other. I think I may be pardoned for saying that those who are most insistent on the electric drive are not at all conversant with the conditions obtaining on board ship, while those of us who have spent a lifetime in the care and design of naval machinery may fairly claim that we know something about what is needed. It is perfectly safe to say that when electric machinery can be used more advantageously than steam for driving ships' auxiliaries, the change will be made very promptly. Knowing, as they do, that as at present designed electric machinery, however good elsewhere, is not yet adapted to driving the auxiliaries on board ship, the bureau chiefs would be incompetent if they yielded to the craze for new things and made a change which would result in increase of weight and complication, lack of economy, dissatisfaction and the decreased efficiency of the fleet.

In this connection I desire to submit the following facts and calculations:

On the battleship "Alabama" the space required for electric motors, where used, is approximately the same as that required for steam engines to do the same work. The space required for the wiring, etc., is less than that necessary for steam piping, had that been used. The space required for the generating sets is 10,140 cubic feet. The capacity of these generating sets is 250 kilowatts total. If all the auxiliary machinery on board this ship were operated by electricity, and if the space required for the electric generators were increased in the ratio of the increase of necessary capacity in the generating room, the space that would be required in the generating rooms would be 50,700 cubic feet for a capacity of 1,250 kilowatts. Consequently upon the extension of the use of electricity would be an increase in the total weight of the machinery equal to from 150 to 250 tons as a minimum. This loss in weight is as much as the gain following the use of watertube boilers. The increased space occupied by the larger generating rooms would accommodate 900 tons of coal, or 3,600 horse power could be added to the power of the propelling engines, giving the ship in the first instance 45 per cent. greater coal endurance, or in the second instance 15 knots increase in speed.

The foregoing figures as to the space required for the installation of large generating sets are undoubtedly excessive, but they are based upon the present practice. It seems to me that at the best we would at present have to pay an excessive price for electricity.

This loss in weight and space would be very much decreased if the size of the electric generating units could be largely increased without loss to the efficiency of the ship. At present, however, it is necessary for the efficient operation of the turret-turning machinery and of the ammunition hoists that small units be used, for these purposes at least. Probably when the designers of electrical machinery for naval use give as much attention to the development of designs to suit naval conditions as they have already done in commercial work, this necessity will be overcome.

I consider that the turbine engine has a distinct field as an electric generating engine, especially on ship-board. When the design of naval electrical machinery is sufficiently advanced to justify the use of large units, the advantages of turbine engines will cause a great saving in weight and space.

The operation of electrical machinery is purely mechanical. That this may be done efficiently requires good mechanical ability at the generating engines. Electric difficulties and casualties are almost always questions of mechanical engineering. I know that it would conduce to the efficiency of the service, to the feasibility of a more extended use of electricity, and to an increase in the life of electrical apparatus if the electric generating plant were placed in charge of this bureau. I therefore recommend that this change be authorized. I desire to call your attention to the fact that it is almost the universal commercial practice to place electric generating plants in the charge of mechanical engineers.

I. B. Osborne finds that the crystallization of egg albumen is promoted on adding acetic acid to the half-saturated ammonium sulphate solution, as pointed out by Hopkins (Journ. Physiology), because the crystallized egg albumen is a compound of the protein substance with acid. When the albumen is first mixed with the ammonium sulphate solution, an alkaline reaction toward litmus can be detected, and a decided odor of free ammonia develops. After this

solution has stood for some hours all evidence of free ammonia disappears, and the solution is then perfectly neutral to litmus, continuing so during the gradual separation of the albumen. The deposited substance, whether in the form of spheroids or crystals, reacts distinctly with litmus and with phenolphthalein, when filtered out and dissolved in water. By the addition of acetic acid, as directed by Hopkins, the albumen is obtained completely crystallized by a single precipitation, and without any concentration by evaporation. But Osborne finds that the substitution of a molecularly equivalent quantity of hydrochloric acid for the acetic acid causes the separation to take place even more quickly.—Journ. Am. Chem. Soc., through Pharmaceutical Journal.

THE FUNGUS INFESTATION OF AGRICULTURAL SOILS IN THE UNITED STATES.*

I SHOULD not have dared to bring before you a paper with this title if it concerned simply the accidental and occasional appearance of fungi in our soils. The matter as it presents itself to me is something quite different from this and something extremely serious in many parts of the United States. Some of you will remember that five years ago before this section, I presented a paper on the subject of the watermelon disease which I had discovered in South Carolina to be widespread and destructive, and due to a parasite living in the soil. Next year I presented another paper on the same subject, giving additional facts; and now I come before you on a somewhat hackneyed subject, I fear (inasmuch as it is a third paper on this same subject), although I have additional facts to offer. The watermelon fungus I have found to be very widespread in the watermelon-growing regions of the United States, from Virginia along the coast, in quite a good many States, as far as Texas; and in certain areas it is permanently in the soils to such an extent that melon growing is practically a failure. In that part of South Carolina where I worked in 1894 and continued in 1895, there are large tracts on which melons cannot be grown successfully any more. This is quite in contradiction to the statement made by our secretary yesterday about not having observed that parasitic diseases in the long run were able to exterminate the host. Taking the case of the watermelon, this fungus is really able, over large areas, to practically exterminate it, so that none now grow in these fields. This is true not only in parts of middle South Carolina but also around Charleston, where they no longer grow large quantities of watermelons. This is true, also, in a portion of South-eastern Virginia, where they are abandoning the growing of melons on account of this fungus in the soil. It is true, also, in parts of Southern Georgia, in restricted areas in Southern Mississippi, and in a very fertile and valuable tract of coast land near Galveston, Texas, devoted almost entirely to trucking and particularly to melons, where they have had practically to go out of the business of growing melons.

The fungi lives throughout winter in the soil, and from year to year in the soil; so that even if melons are not planted in such soils for from three to seven or more years, and are then planted, the parasite is still there ready to attack the crop. How long is required to eliminate the parasite from the soil, after once thoroughly infested, is not known. I do not see why it cannot stay in the soil just as long as the Canada thistle, and it is much worse than the thistle because it is an unseen enemy. It attacks the plant exclusively from the soil. It is a soil parasite. I used to read, years ago, in papers by Mr. Kirke, of New Zealand, of a terrible soil fungus that they had in their country which was said to creep through the earth and destroy every green thing, leaving nothing. It seemed to me most wonderful; but so far as this one plant goes, we have here a fungus equally capable of making a clean sweep.

That is not the only parasite of its kind which I know of. In 1894 I had samples of cotton sent to me from Georgia identical with that described by Professor Atkinson, in 1892, in a Bulletin from the Alabama Station; and I have since seen numerous samples of cotton infested by a *Fusarium* under conditions making it seem as if it were unquestionably parasitic. Professor Atkinson left the subject somewhat uncertain as to parasitism; but although I have not secured infections with it, the fungus occurs so constantly in the diseased plants, and year after year on this soil, that I think we must assume this also to be parasitic; and it is so destructive in certain fine cotton regions of the South that the cotton growers are thoroughly discouraged; they do not know what to do. In one of the best cotton-growing sections (namely, that narrow belt along the coast from the middle of South Carolina to Georgia, known as the Sea Island cotton region), it is so bad in many of the fields that the growers have simply turned out these fields as waste land. One large and heretofore very successful cotton grower wrote last year that he had abandoned 15 per cent. of his cotton land on account of this parasite. He has a very large and extremely rich plantation; and it would astonish you to see what care he takes of his land, and also what care the other intelligent growers of that region pursue in reference to their cotton land. They breed cotton as carefully as anybody in the North breeds any cultivated plant; and their land is tilled, drained and fertilized higher than any Northern farmer can afford to fertilize, and the Sea Island cotton is worth three or four times as much as ordinary cotton; so you see the immense loss to them by this parasite.

These two are not the only plants attacked by parasites belonging to this group. There is one which attacks the cow-pea, a common forage plant of the South, and in some cases, damages whole fields. These three parasites, with which I have worked since 1894 and 1895, are so nearly alike that I have been extremely puzzled to separate them into anything but one species; yet, when I make cross-inoculations, I cannot get any cross infections that would indicate them to be the same fungus.

I have secured extremely satisfactory infections on the melon plant, using pure cultures of the melon fungus. In the fall of 1894 (I recorded in a foot note to abstract in Proc. A. A. S. 1894), I obtained beautiful infections and have carried the work on since. The

* A paper by Dr. Erwin F. Smith, Department of Agriculture, Washington, D. C., read August 25, 1896, at the Ohio State University, Columbus, O., before the Botanical Section of the American Association for the Advancement of Science.

number of melon plant infections which I have now obtained with this melon fungus exceeds 500, and every one of these, so far as I know, has been obtained without any mechanical injury to the plant itself; that is, I have not put the fungus into the melon plant by breaking the tissue in any way, but have simply buried a little bit of this fungus in the surface layers of the soil and have allowed the fungus to get into the plant the best way it could. In more than 400 of these diseased plants I have demonstrated the presence of the fungus inside of the vessels of the plant in good quantities (sufficient by a microscopic examination to account for the wilt). I have also cultivated out this fungus repeatedly from the interior of these plants and always found it to be the same organism. This has then been inoculated into other soils and obtained the disease again. I have had great quantities of check plants during the course of these experiments, and, with the exception of four plants, I have had no cases of disease in any of these control plants. These four accidental infections occurred toward the close of the experiment, so that, on the whole, the controlled work has been very satisfactory.

Here is a drawing which shows very well the way the fungus infests the water ducts of the plant and fills them up and causes the wilt. When the plant is in this stage of the disease, the foliage wilts, and, if the weather is at all dry, it never recovers. If the weather is very moist, the leaves may recover and the plant seem all right again until the rain has passed away and the sun comes out, then it droops again and stays down. This may happen at any stage in the life of the plant, from the seedling just coming up and without any leaves except cotyledons to the plant covering an area of over ten feet square and bearing one or two fine melons, two-thirds grown. There are no parasites on the surface in this stage; the part of the plant between the stem and the root appears to be sound externally and there is no indication whatever as to the cause of the trouble; but if you make a cross-section of the stem, and examine it under the microscope, you see in the vascular system what appears like a stuffing of white cotton. These white threads produce an enormous number of elliptical conidia which germinate readily and soon we have the ducts packed solid, in many cases, with the fungus. This drawing, which was made from one of my paraffine embedded microtome sections, shows fairly well the manner of the fungous infestation.

The fungus comes to the surface as the plant dies, and fruits in an entirely different form, a true *Fusarium*. The fungus on the inside is more of a *Cephalosporium*. Later on (usually from August to November) we have perithecial fruits, scattering and, as a rule, not high upon the stem but close to the surface of the earth, or under the earth. They constitute a new genus lying between *Neetrella* and *Melanospora*. These have been overlooked for a long time because they grow in such out-of-the-way places, down under the earth, or near the soil.

The following is a sample inoculation experiment. I took a bed of good soil, 6 feet long by 3 feet wide, and making furrows 4 inches apart the narrow way, and about an inch deep, I buried in the bottom of these furrows cultures of the pure fungus. A day or two later, I planted my melons in rows between these fifteen rows of the buried fungus. These melons began to wilt in a few weeks, soon after they began to come up.

When I saw that the melons were starting to wilt, and had discovered by microscopic observation that fungus was in the ducts, I planted cotton and cow-peas between the rows of melons; i. e., right over the rows of the buried fungus. The cotton and cow-pea plants grew admirably for four or five months, except that toward the close they were crowded. All of the melon plants wilted. There were about 200 of these. That is one of many discouraging experiments which I carried on with this fungus to determine whether I could cross-inoculate or not. Morphologically it appears to be one thing, while physiologically it appears to be three things.

These are not the only diseases of this kind I know of. In parts of New York there is a cabbage disease which bids fair to put an end to the successful growing of cabbages in considerable districts, and that is due also to a soil *Fusarium*.

I made my first study of that in 1895 from a lot of material sent me from the eastern part of the State, near Albany; but while I made microscopic examinations and cultivated out the fungus, I did not then make inoculations; but the fungus was constantly present in the vascular system, and the disease was of such a nature as to indicate that the fungus was the cause of the disease. I finally had a bushel or two of this soil sent me from a field where cabbages could no longer be grown successfully. Where formerly the man obtained from ninety to ninety-five thousand good cabbage-heads from every hundred thousand plants set out, he now gets only about thirty thousand marketable heads. That soil remained in a dry cellar for three and a half years and was then unpacked and planted to cabbages, whereupon the cabbage disease appeared, indicating that the fungus will live in the soil three and a half years. The melon fungus has also lived dry in culture tubes three and a half years. Probably, therefore, in all of these soil *Fusaria* we have to deal with extremely resistant organisms. These fungi grow beautifully in horse dung and feebly in rotten wood, and will probably grow for a time on whatever vegetable refuse there may be in the soil.

Eastern New York is not the only place where I have found this cabbage disease. It is also destructive in parts of Maryland. Fields in Maryland this year which bade fair to make a fine crop have been plowed up and planted to other crops on account of it. It is in a number of places in Maryland, and very likely it is in other parts of the United States.

There is also a disease of tomatoes, in Florida, which in some places has put an end, practically, to the growing of tomatoes for the early markets in the North. This is also due to a parasitic *Fusarium*, one different, apparently, from any of these others I have mentioned; that is, I cannot cross-inoculate tomatoes with the melon fungus. I have had one hundred tomatoes growing from the seedling stage in a bed where all the melons were wilting, and the tomatoes grew successfully for three or four months, indicating that the melon fungus is not parasitic to the tomatoes.

A similar *Fusarium* has been found plugging the vascular system of sweet potatoes sent from Iowa, and

obtained from Washington, D. C.; and Dr. Halsted has done some interesting work on the same or a very similar disease which occurs in New Jersey; so that you see there are a number of important cultivated crops in this country attacked by soil fungi, the very existence of which we did not suspect a few years ago. These fungi live through the winter, and once in a cultivated field, they stay there and put an end to the successful growing of that particular crop.

The important point for the farmer is, what to do. The few experiments I have been able to make have all been negative, so far as preventing the attacks of the fungus on the plant is concerned. Spraying with Bordeaux mixture is of no advantage. All that I can say yet to any grower is, that you must not get this fungus into your soil, keep it out. I know in certain ways how it has been distributed by the farmer; for instance, the South Carolina farmers have distributed it from the melon field to the hay mow in wild grasses cut late in the season from such fields. Along with this hay they raked up these diseased vines, which were carried into the barn. The fungus lives in the plant over winter in a dry state, and when this "melon hay" is fed to the cattle or used as a bedding, an immense culture pile of the fungus is unwittingly made in the barnyard; and then this is hauled out and put on the fields; and so new land is infested and the thing is spread.

The original trouble possibly comes from the neglect of what I consider to be one of the fundamental doctrines of agriculture; and that is, the careful rotation of crops. As you all know, in this country that is greatly neglected. A man has a piece of land, suitable for cabbages, or melons, or cotton, and he plants it year after year to cabbages, or melons, or cotton. Of course the chances are he gets his land "sick," as he says; he gets quantities of decaying tissue of these plants in the soil and in admirable condition for the propagation of all these fungi from year to year; and yet it is the hardest thing to persuade a man who has put his money in a special crop, and knows how to grow it, to abandon it for other crops. However, that is the only way these lands can be made of any practical use to the farmer. Those lands that are still free should be kept free by care in what the farmers do. They need not borrow their neighbors' cultivators or plows that are infested with this fungous earth and plow their fields with them; they need not pasture cattle on diseased fields; and in various other ways they might avoid spreading it in their fields. The infested fields should be abandoned for a series of years, or used for other crops. Of course all diseased plants should be pulled and burned.

I think I have said enough to show to what extent the agriculture of special crops is threatened in parts of the United States through organisms which are very resistant and which live from year to year in cultivated soils unsuspected in many cases by the farmer, he observing only the result that whereas formerly he grew certain crops successfully, he cannot do so now.

(A full account of these diseases will be published in Bull. 17, Div. Vegetable Physiology and Pathology, United States Department of Agriculture.)

VENTILATION AND SANITATION OF THEATERS, CHURCHES, AND RAILWAY CARS.

SIR WILLIAM PREECE, in the course of his presidential address delivered at the meeting of the British Sanitary Institute, recently held at Southampton, referred to this subject. Sir William Preece spoke as follows: "Thus the whole theory of ventilation is circulation of air maintained at a proper temperature, for cold air may be injurious. The British legislature has taken care that lunatic asylums, hospitals, work-houses, and jails shall be well supplied with proper air space per person, and shall be supplied with effective means for ventilation; but churches, theaters, meeting halls, assembly rooms, railway carriages, and other places where healthy and well-to-do persons most do congregate are totally neglected and remain sinks of discomfort." This evil exists probably to quite as great an extent in this country as in Great Britain, and now that the theater season has just commenced, the time for once again attracting notice to this unpleasant state of affairs is distinctly apropos. Until the patrons of theaters show their dissatisfaction with the present sanitary conduct of play houses in a practical manner, the proprietors thereof are not likely to make a move. If, however, theatergoers decide to boycott those theaters which are notoriously defective in ventilation and general sanitation, the result will be that a radical change will quickly be brought to pass. Similar remarks apply with equal force to railway cars. So far as churches are concerned—although in many good hygienic arrangements are woefully lacking—the remedy is more difficult to suggest. Nevertheless the majority of American churches are supported by their congregations, and if these congregations refuse to endanger their health by attending services in buildings in which the sanitation is bad, the result would doubtless be that the causes of offense would be forthwith removed and the defects put in order.—Medical Record.

Tuberculosis Among Belgian Cattle.—Consul Roosevelt, of Brussels, August 23, transmits the following:

The Minister of Agriculture has invited provincial agricultural societies to make known to farmers and cattle breeders, through the medium of lectures, notices, and circulars, the means of fighting the increase of tuberculosis among cattle. Their attention is to be notably drawn to the hygiene of stables, as in many districts, especially the Campine and Ardennes, the stables are very badly kept. The peasants are afraid of leaving the doors of the stable open, on account of draughts, which they think highly injurious to the cattle, and it is difficult to make them understand that stables are contaminated when deprived of fresh air. Also, very little attention is given to cleanliness. Frequently the litter is allowed to accumulate for weeks and even months, until the unfortunate animals stand knee deep in it. Under such conditions it is easy to understand that such stables become propagating beds for the germs of tuberculosis. As it is difficult to make the peasants understand that upon the cleanliness of the stable largely depends the eradication of the disease among their cattle, it has been determined to organize competition, awarding premiums to farmers taking good care of their cattle and stables.

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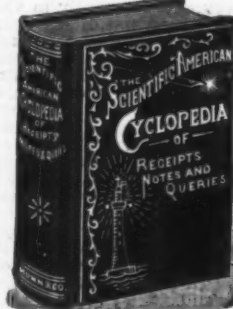
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